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NOTES AND COMMENTS.

Continuous Melting.

At the recent Convention of American Foundrymen, among the many instructive and interesting papers presented perhaps none excited so much interest and comment as that by Mr. Sleeth. That gentleman, it will be remembered, dealt with "Continuous Melting in the Foundry of the Westinghouse Air Brake Company," and described what might be termed a highly specialised system of the continuous production of standard moulds, and continuous melting and pouring of the metal. There can be no doubt that where a fairly regular product is being turned out this system lends itself to very considerable economies, and much greater attention might well be directed to the question by some of our own foundries. But there is another phase of the question of continuous melting that should be considered even by much smaller foundries than that described by Mr. Sleeth. Continuous melting could be carried out with the ordinary cupola in numerous foundries if a little attention were given to organising the work to such an end; and while in many cases no advantage would be experienced over the practice of pouring the heat at the end of the day, in others far greater flexibility of capacity would result. For instance, instead of the moulding floor being piled up with the moulders' output until the whole could be cast at once, casting would be done at short intervals, as found convenient. This, of course, mainly applies to comparatively small work, for where only large castings of, say, several hundredweights each are being made, the system would present practically no advantages. But with small work the moulding could be done nearer the furnace, less carrying of metal would be involved and the floor space needed for moulding would be considerably reduced. Such a system of continuous melting would involve some adaptation of the ordinary cupola, and radical change in the method of charging, blowing, etc., but these considerations are not such as need deter anyone who conceives possible economies in the system. It would, of course, be necessary to arrange for the tonnage of the moulds to be such at each pouring as to accommodate as near as possible the metal coming down. To any foundry handling a variety of work this could be met by organising the work on the moulding floor, while for a foundry dealing mainly with standard articles and sizes the question would be practically solved already.

Moulds for Casting Aluminium.

While metal moulds have been used with great success the shrinkage of aluminium is too great to allow anything but simple shapes of that metal to be made in such moulds. It is well known, however, that when aluminium is cast in metal moulds, owing to the sudden chilling it becomes much stronger and harder than when cast in green sand. A new form of moulding sand for use in casting aluminium has been invented and patented by Mr. Earl Blough, of

the Aluminium Company of America, of Pittsburg, Pa. (U.S. Patent 915,728, March 23, 1909). The sand is used in exactly the same manner as ordinary moulding sand and, therefore, no change in moulding methods are necessary. The material is a sort of ground carbon mixed with the usual moulding sand. This carbonaceous material may be of various kinds, but the following composition is given by the patentee as being very good:—Petroleum coke 50 parts, electric light carbon 25 parts, and coal-tar pitch 25 parts. The whole is mixed and then baked at a high temperature, after which it is finely ground. This finely ground carbon is then mixed with the moulding sand in the following proportions: Moulding sand, 85 lbs.; ground carbon, 15 lbs. The carbon is ground as fine as necessary for any particular purpose, but for ordinary use a 200-mesh sieve is recommended. The advantage of the carbon in the moulding sand is that it is a good conductor of heat, and thus serves to chill the aluminium. In this manner it acts similarly to a chill mould, but at the same time does not produce a rigid mould, as the sand is moulded in the usual manner. The patentee states that the grain of the aluminium cast in the mould is finer and the metal sounder and stronger. With an alloy containing 92 per cent. of aluminium and 8 per cent. of copper, it is stated that the tensile strength is increased from 15 to 25 per cent. when cast in a mould made in this manner.

Cast-Iron Moulds.

In view of the foregoing, and also in view of the expressed difficulty of accommodating the shrinkage of aluminium in cooling, it is interesting to recall a casting which was shown to us by Dr. Szèkely, the patentee of the Szèkely process of casting in permanent moulds. This casting was by no means a simple one, and weighed something like 60 lbs. It was designed for use as a machine part, and contained numerous recesses and similar intricate parts; but despite this the casting turned out with a beautiful finish, and fitted cleanly into the permanent mould in which it was cast. The shrinkage, we understand, was met by a system of clamping the mould parts together by means of special spring attachments, which allowed a little play when the metal was first poured in, and closed tight on it as it shrunk. How far this system could be applied to other work we are not in a position to say, but the firm for whom this casting was made expressed complete satisfaction with it. The cores used, it may be mentioned, were of a special preparation, the nature of which the inventor would not disclose, but they were sufficiently hard to withstand being sharply struck against iron without suffering damage.

There is no doubt that, apart from those processes which are more or less of a special nature, there is considerable room for improvement in the design and use of permanent moulds for aluminium, as well as for other metals. It is necessary, however, to be prepared to discard entirely the practice and ideas which time has honoured, and which are pursued to-day with veneration, if any great advance is to be made. It may not, of course, be necessary to do so; but many an investigator has stopped short of success on account of undue respect for the things that be. At the same time, we do not stop walking because aerial navigators have managed to attain express train speed through the air; and we will not discard the sand mould because the metal one can be successfully employed for some work.

British Foundrymen's Convention.

We have received from the Secretary of the British Foundrymen's Association the report for the past year, and the programme of the forthcoming Convention at Birmingham, and these we present on another page. The record of the Association's work during the past session is an admirable one, and the success which has attended the efforts to promote the interests of our foundrymen is worthy of unqualified praise. The advance in the membership of the Association is by no means a meagre one, the figure now being 448, consisting of 6 life members, 39 honorary members, 311 members, and 92 branch associate members, as compared with 5 life, 29 honorary, 286 members, 62 branch associate members the previous year. The net gain is thus 66. The quality of the work done in the different branches has also been well maintained, and, in fact, the whole organisation may be said to be steadily advancing.

We should like also to commend the manner in which the report and programme has been placed before the members. These are embodied in a neat hand-book, the programme, which gives not only the titles of the papers, but also a brief synopsis of the same, being interleaved with pages for notes. All desirable information in regard to the various items of the programme is carefully catalogued, and, in short, everything has been done to meet the convenience of the members. If this is a criterion of other efforts put forward in connection with the Convention, it should prove a particularly happy and successful gathering.

Making Phosphor Tin.

For the manufacture of phosphor-tin the following method is recommended in preference to the ordinary method of introducing the phosphorus into the molten tin by means of a phosphoriser. Sponge tin is prepared by melting pure Straits tin and pouring it from a height of several feet into a tub supplied with running water. The sponge tin is then removed and thoroughly dried, or the tin may be prepared in the form of fine shavings. Cakes of yellow cake phosphorus are placed in a saturated solution of copper sulphate for about ten minutes, shortly before they are used, in order to give them a very thin coating of metallic copper so that they may be handled with safety, and they are then dried by rolling in sawdust. The requisite amount of phosphorus (5 per cent. is the usual content for phosphor-tin) is placed in the bottom of a plumbago crucible, covered with the dry, sponge tin, some powdered charcoal added, and the lid of the crucible tightly sealed with a mixture of loam and fireclay. The crucible is heated slowly until the phosphorus has cut the tin and combined with it. The resulting phosphor-tin is then skimmed and poured into suitable moulds, preferably of small size, and set in running water like solder moulds.

English v. American Pattern Shops.

A writer in an American contemporary draws a comparison between the manner of driving machinery in the shops of that country and of England. He remarks that the general method in America appears to be the overhead belt drive, while in England the system largely favoured is that of running all belts and shafting, where possible, under the floor, so that they do not in any way interfere with the worker. The former system requires often a number of belts, in proportion to the number of machines, running from the overhead beams, and as it is quite necessary to have some of the machines in a pattern-shop well away from the wall, some of these belts must occasionally come in the way when long material is being handled. While the worker will in time get accustomed to the presence of these belts, it is much better to have the overhead space as clear as possible;

especially where an overhead crane is installed for handling large patterns. Belts also create a certain amount of draft, which tend to keep in motion the fine dust from the saws, lathes, etc., and there is likewise the danger of breakages with the overhead belts.

It will be readily seen that with the system commonly adopted in England these troubles are to a very large extent avoided. Lathes are generally fixed along one side of the shop. In some instances they are driven direct from the overhead shaft by friction clutches fixed on the main shaft itself, thus avoiding countershaft pulleys, shaft, and belt for each machine. The larger machines, such as saws, band and circular saws, planing and thicknessing machines, combination saws, and similar machines, are belt-driven by a below-floor belt. In the first of two or more bricked trenches a short countershaft is fixed with two pulleys, one to take the belt from the main overhead shaft, the other to drive the next countershaft, whence the various machines are driven by suitable pulleys. The trenches are protected by heavy wooden covers made in parts so as to be easily handled. This system leaves the room quite clear overhead and interferes with very little more floor space than is actually needed by the machines themselves. It altogether obviates the possibility of workmen getting caught by belts, as movable wooden covers are provided to guard the pulleys on the machines and the short lengths of belt that come up through the floor.

We have often been told that we have much to learn from America in the direction of shop-equipment and management, but here, at least, that country may with advantage take a tip from us.

Wasters and the Responsibility.

On another page we publish some notes on "Wasters in the Foundry," the author of which touches on the delicate question of the amount of wasters produced by different men. He suggests that the reputations of some foremen for keeping down the production of waste castings would suffer were a visit paid to the foundry and the charging platform before a chance of destroying or disposing of bad castings occurred. There may be a good deal in this suggestion, and in jobbing foundries particularly a remarkably low output of wasters is often recorded—frequently less than in many a highly organised and supervised shop. But, granted that such deception does occur, it is generally the fault of the principal, and results from lax supervision and inconsiderate demands on the foundry foreman. Too often the foundry is owned by a man having very little practical knowledge of the work, who conceives it possible and reasonable to expect that no waste castings should be produced. He does not realise any of the difficulties of the work, and classes any faulty work as the result of sheer carelessness. Consequently the foreman, in order to meet the demands that are placed on him, has recourse to subterfuge, and this is no difficult matter unless a strict system of cost-keeping is in vogue. While it cannot be regarded as just honest to hoodwink one's employer in this way, when a man knows his job depends on his ability to show an abnormally low production of bad castings, it cannot be a matter of great surprise or condemnation if he descends to such a course. The only way to get fair treatment from the foundry is to demand a reasonable output, and to then give the conduct of the work proper supervision.

World's Production of Pig-Iron.

The following statistics, showing in English tons the world's production of pig-iron during the years 1906-8, have been compiled by the Comité des Forges de France:—

	1906. Thousands of Tons.	Per cent. of Total.	1907. Thousands of Tons.	Per cent. of Total.	1908. Thousands of Tons.	Per cent. of Total.
United States	25,308	43.2	25,782	43.0	15,936	33.5
Germany ...	12,281	20.9	12,837	21.4	11,616	24.4
Great Britain	10,149	17.3	9,924	16.6	9,290	19.5
France ...	3,314	5.6	3,531	5.9	3,337	7.0
Russia ...	2,661	4.5	2,775	4.6	2,600	5.4
Austria Hungary	1,688	2.8	1,843	3.0	1 650	3.4
Belgium ...	1,354	2.3	1,384	2.3	1,185	2.5
Canada ...	542	1.0	581	1.0	563	1.1
Sweden ...	596	1.0	606	1.0	554	1.1
Spain ...	373	1.4	373	1.2	373	2.1
Italy ...	135		110		110	
Japan ...	42		43		43	
Other C'ntries	200		200		200	
Total ...	58,643	100	59 989	100	47,459	100

It is interesting to note that the world's total production declined in 1908 to below the figure for 1905 (53,700,000 tons), though it was higher than in 1904 and 1903, during which years the output was estimated at 45,050,000 tons and 46,000,000 tons respectively.

Institute of Metals.

The Institute of Metals has just completed the first year of its existence, during which period the membership has increased from barely 200 to well over 500. The first volume of the "Journal" of the Institute is now in the hands of all members, and shortly they will receive notification of the forthcoming autumn meeting. This will take place at Manchester, on Thursday and Friday, October 14 and 15. The arrangements, which are in the hands of a strong local committee, are already well advanced. A series of about half a dozen papers of interest quite equal to those presented at the Birmingham meeting of the Institute, in November last, will be read and discussed at the two morning sessions of the Institute. The afternoon of the first day will be devoted to a visit to the University of Manchester, where members will be officially received on behalf of the University by Vice-Chancellor Alfred Hopkinson, K.C. The new engineering laboratories will be open for inspection, and facilities will also be given for inspecting the Municipal School of Technology. In the evening a reception will be held by the Lord Mayor at the Town Hall. During the afternoon of Friday, October 15, members will have the opportunity of visiting works of metallurgical interest in the neighbourhood of Manchester.

The work of the Institute has increased so considerably that the present offices, which were occupied by the Institute staff for the first time as recently as January last, are already proving to possess insufficient accommodation, and it is, therefore, the intention of the Institute to remove into a more commodious suite of rooms at the earliest possible moment.

We learn that when Sir William White, K.C.B., retires from the Presidency of the Institute at the end of the present year, it is almost certain that Sir Gerard Muntz, Bart., will be nominated to the vacant office. The vacancy in the Vice-Presidency caused by the recent death of Mr. Norman Cookson, of Newcastle-on-Tyne, has been filled by the Council, which, at a recent meeting, unanimously elected Dr. H. C. H. Carpenter, of Manchester.

Making Malleable Castings.

The active study of science has thrown light on many problems and made numerous well-guarded trade secrets common property. For a long time, however, comparatively little attention was bestowed on the production of malleable castings, but of late years, this branch also has been thoroughly investigated by Hatfield and others. One of the most practical contributions to the subject, from the point of view of British practice, is a recent paper by Mr. J. Mathews, read before the British Foundrymen's Association.†

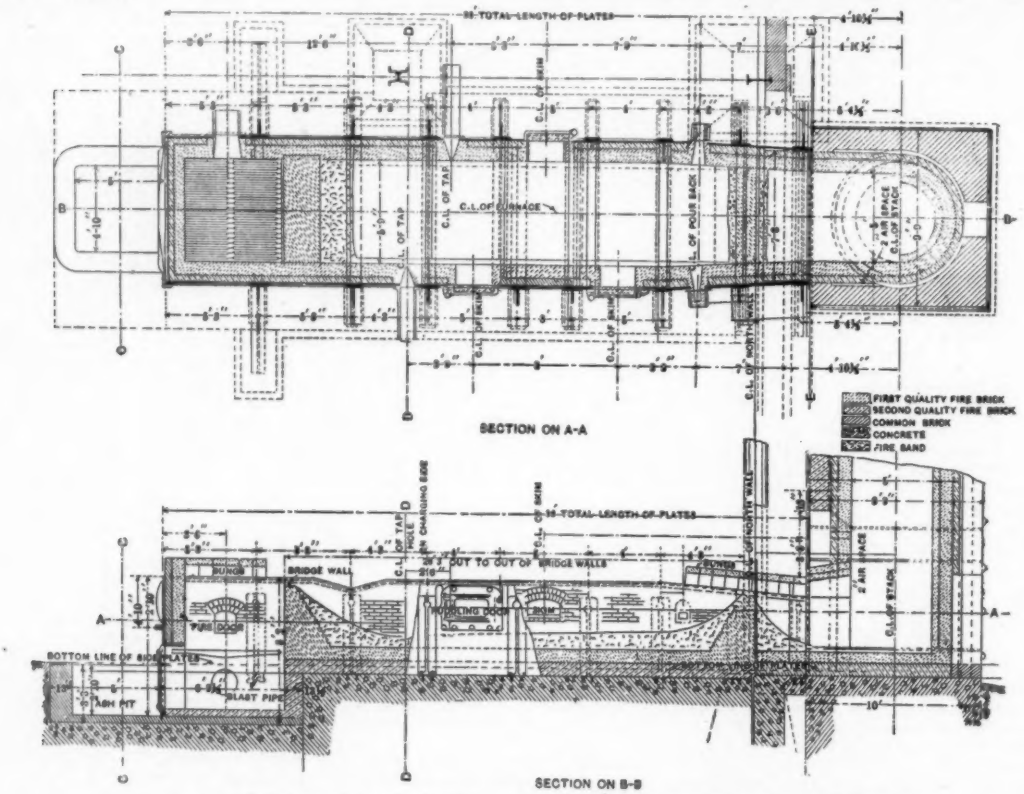


FIG. 1.—SECTIONAL PLAN AND ELEVATION OF 15-TON REVERBERATORY FURNACE FOR MALLEABLE CASTINGS.

White cast iron, in which the carbon is not separated in the form of graphite—a matter of composition or of rapid cooling—contains the largest proportion of its carbon as a carbide, with the formula Fe_3C, the metallographical name for which is cementite. This substance has the property of decomposing into its components on prolonged heating to a suitable temperature, so that the hard cementite is replaced by pure iron (ferrite) and carbon (temper carbon), thus rendering the metal soft and malleable.

According to Mr. E. Schoemann‡ there is now little doubt that the phenomena occurring in the production of malleable cast iron proceed in two sharply defined periods, the first of which is the breaking up of the cementite, that is to say, the separation of the temper carbon at the end of a given time at a certain temperature, the elmination of carbon, the actual fining process, commencing afterwards. The first stage is sufficient to render the metal soft and malleable (American "black heart" cast iron). The decomposition of the carbide proceeds the more rapidly and at a lower temperature, in proportion as the chemical composition of the metal is more suitable. A manganese content of over 0.4 per cent. retards the separation of the temper carbon; and sulphur, even in small quantities, is still more energetic in this connection. On the other hand, silicon is favourable, the temperature and time required for the decomposition of the carbide decreasing as the silicon content rises. Hence it is desirable to see that the metal contains as much silicon as possible, compatible with mildness and the prevention of graphite formation (this depending chiefly on the thickness of metal in the casting). For practical purposes, the lowest limit of silicon is about 0.5 per cent., and the upper limit about 1.2 per cent.

The time required to eliminate a portion of the temper carbon, by oxidation, during the second period (the actual fining stage) depends on the amount of carbon present. The larger the proportion of carbon

† "Foundry Trade Journal," May, 1909.
‡ "Stahl und Eisen," April 21, 1909.

in the casting, the longer the time required for its removal, and *vice versâ*. It should be pointed out that there are limits to the diminution of the carbon content of unannealed cast iron, and that, on the other hand, certain technical difficulties occur in connection with pouring, owing to the increased melting temperature as the carbon content is lowered, these difficulties showing themselves in the formation of blow holes and in unsatisfactory pouring. For thick-wall castings the lowest limit of carbon which enables these difficulties to be avoided is about 2.5 per cent., and for thin-walled castings about 2.6 to 2.7 per cent.

Certain other advantages, in addition to the saving of time, result from a low carbon content. The temper carbon forming on the decomposition of the carbide naturally loosens the texture of the iron, and, therefore, has an unfavourable influence on its tensile

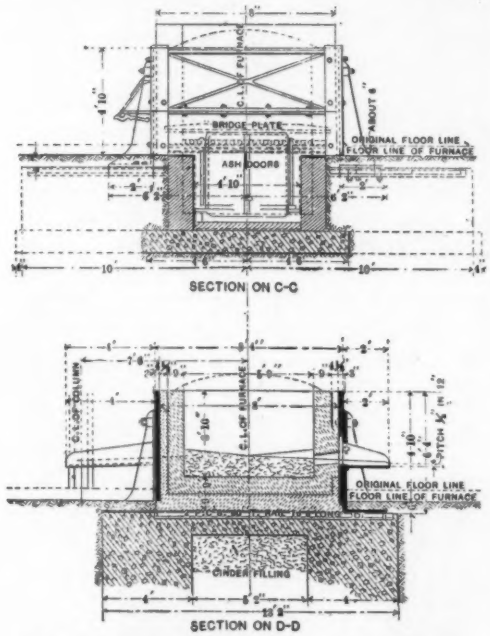


FIG. 2.—CROSS SECTIONS OF 15-TON REVERBERATORY FURNACE FOR MALLEABLE CASTINGS. (FOR SECTION LINES SEE FIG. 1.)

properties, this being the more pronounced the higher the total carbon content of the cast iron and the larger the quantity of temper carbon consequently formed. By lowering the carbon content this inconvenience is rendered less apparent, so that the tensile properties of the casting, especially the breaking strength and elongation, are improved.

It is also known that when the carbon content is low, the permissible amount of silicon that can be added to prevent the formation of graphite may be increased. This possibility of raising the silicon content facilitates the decomposition of the carbide—an important consideration in helping the process to go on smoothly.

An examination of the usual melting processes shows that the best theoretical composition of malleable cast iron cannot be obtained in all cases. In the cupola furnace a considerable enrichment in sulphur occurs, with a corresponding absorption of carbon when the initial carbon content of the charge has been low, so that castings low in carbon cannot be produced by this method. Melting in the crucible is far more favourable, since in this way any desired carbon content can be obtained, and the undesirable enrichment in sulphur avoided. Against these ad-

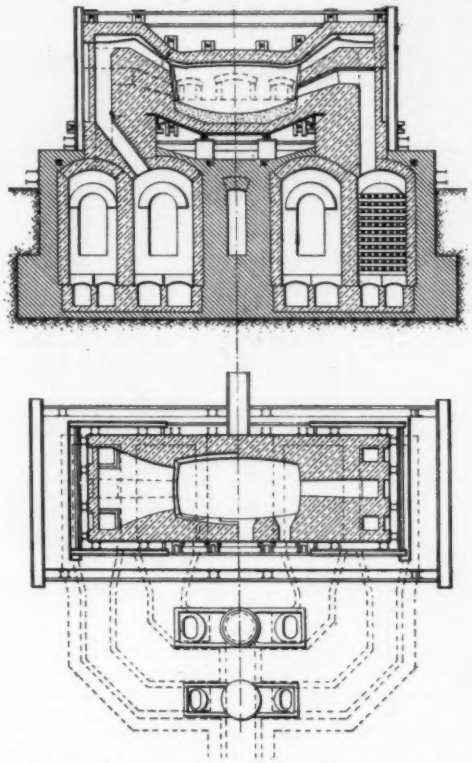


FIG. 3.—SECTIONAL PLAN AND ELEVATION OF SMALL ACID-LINED OPEN-HEARTH FURNACE FOR MALLEABLE CASTINGS.

vantages of the crucible must be set the higher cost and somewhat cumbrous method of working—a point of some importance when a large production is in

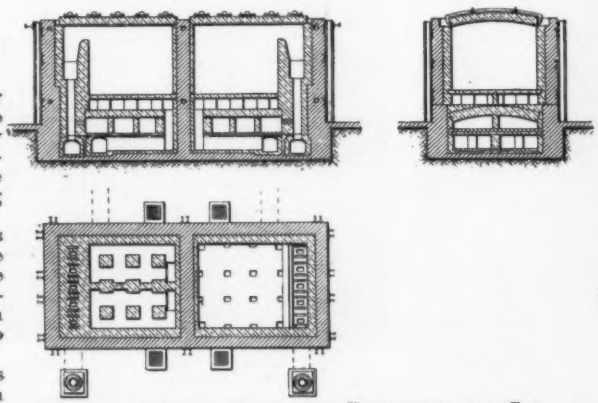


FIG. 4.—SECTIONAL PLAN AND ELEVATIONS OF GAS-FIRED ANNEALING FURNACE FOR MALLEABLE CASTINGS.

question. On this account endeavours have been made to find a more convenient method of melting, which should furnish a good quality product at a low

cost. Such a method is provided in the open-hearth furnace, which is cheap to work, is free from the defects of the cupola furnace, and unites in itself all the good points of the cupola furnace.

More than twenty years ago the open-hearth furnace was employed in the production of malleable cast iron, and at present this method has been largely adopted, though success has not been attained without considerable trouble, the difficulties encountered requiring considerable experience to surmount.

FIG. 5.—SMALL OPEN-HEARTH FURNACE FOR STEEL AND MALLEABLE CASTINGS.

In the United States the air or reverberatory furnace is principally used for melting. The air furnace is not, of course, as cheap as the cupola, but the inferior quality of castings obtained from the cupola more than offsets the greater cost of air-furnace malleable castings. On the other hand, the open-hearth furnace, if run continuously, is not only cheaper than the air furnace, but produces a better grade of casting. It has its disadvantages, however, and can only be economical in very large works. Mr. W. H. Kane, of Zanesville, Ohio,* has described a 15-ton reverberatory furnace, which is shown in the illustrations, Figs. 1 and 2. He points out that in building an air furnace it is very necessary to put in a slow fire to dry out the walls and bungs before silica sand bottom is put in. He writes as follows:—

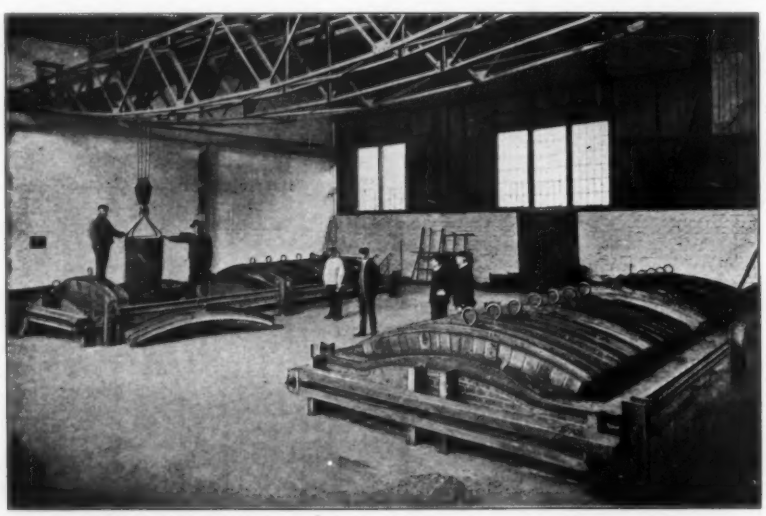


FIG. 6.—GAS-FIRED ANNEALING FURNACES FOR MALLEABLE CASTINGS.

The sand used for the bottom must bake well. It should be the best that can be had. Old firebrick

* Paper read at the Cincinnati Convention, May, 1909, of the American Foundrymen's Association.

ground up and run through a No. 4 riddle, when mixed with sharp sand, will make an excellent bottom. Ground firebrick and fireclay mixed up for a daubing for side walls and spout, and to make the breast, give about the best results. The same mixture is used for lining ladles. Old grindstones, pulverised fine and rammed down hard, make a furnace bottom that will stand for several weeks.

There is no hard-and-fast rule for making the plates and stays of an air furnace. Some foundrymen make very large plates—6 ft. to 8 ft. long and 5 ft. high. Others are 3 ft. to 4 ft. in length and 12 in. to 18 in. wide.

After the plates are set and have been bolted to the buckle plates, the walls are built to the proper height. The openings over the bridge walls are a most important point, as on it depend the working of the furnace and the coal consumption. Mr. Kane puts the opening over the front bridge wall at 18 in. centre of bung and the back opening 6 in. centre of bung. A water gauge records the blast pressure, which with about 3 in. and the openings above-mentioned give good results. He also states that the grate should be at least 12 in. below the door, so that a bed can be carried from 12 in. to 16 in. in depth. As to the bungs, there are various styles in use. One has a single brick, or 9 in. Another takes a brick and a half, or 13 in., and still another two bricks, or 18 in. in width. The frame is made in various ways. The old style had rods running the entire length and could be tightened from both ends. The latest designs work better and have the tightening accomplished by means of set screws. These bungs rarely drop out, holding the brick well through the various phases of expansion and contraction.

The use of a waste heat boiler in the stack, or at the back of the stack, with proper damper facilities to use boiler or furnace independently, is advisable.

[These notes by Mr. Kane were published in our issue of June last, but we deem it advisable to include them in this article, and we also reproduce the drawings (Fig. 7), showing the details of the bungs.]

Little has been published on the practical working of foundries producing malleable castings by the aid of the open-hearth furnace, and, consequently, particulars of this nature should be of interest. Messrs. F. W. Killing, of Hagen-Delstern, whose works, established in 1871, were reconstructed in 1906 by Messrs. Poetter & Company, of 39, Victoria Street, S.W., the business having outgrown the capacity of the old crucible-furnace plant, melt the metal in an acid open-hearth furnace, the gas producer of which also heats the annealing furnaces. The casting shop, which is about 240 ft. in length and 100 ft. wide, is arranged in three bays, and is well lighted and ventilated. It is equipped with high-speed electric travelling cranes for the rapid transport of the materials and finished products.

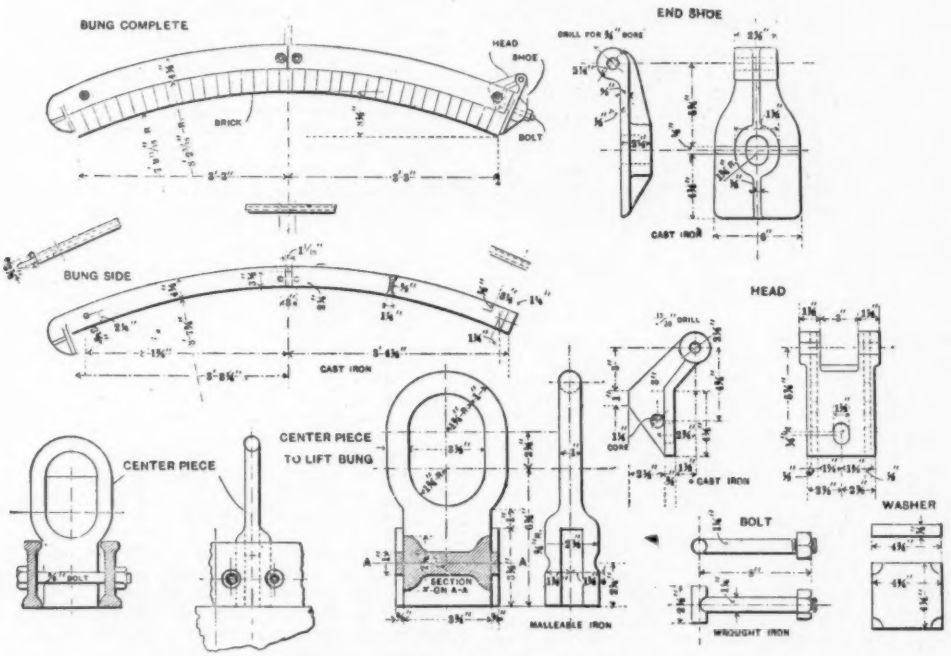


FIG. 7.—DETAILS OF BUNGS.

The moulding sand is carefully prepared in a well-equipped shop, so as to obtain the cleanest possible castings. The metal is melted in a small open-hearth furnace capable of holding 3 to 4 tons, three charges being treated per day, and each taking three to five hours. Fig. 3 shows the design of this furnace, with reference to which care has been taken to provide for subsequent enlargement, by taking the heads apart and lengthening the furnace without any heavy cost.

For the reasons already advanced, the open-hearth furnace is the best for the purpose in view, when a large output is in question, provided the necessary precautions to prevent failure are adopted. The chief peculiarity of the open-hearth process resides in the changes to which the metal is subjected by the oxidation of manganese, silicon, and carbon. These oxidation processes form a characteristic feature of the production of steel in the open-hearth furnace, whereas in the manufacture of malleable cast iron

they have to be accepted as inevitable accessories, and the furnace must be regarded solely as a means for liquefying the iron.

In order to obtain the requisite silicon content in the molten iron it is, therefore, necessary to take the losses into account in preparing the charge. These losses amount to an average of 10 to 15 per cent. when the furnace is properly worked and is tapped as soon as the metal is hot and ready for pouring. Slow working will invariably lead to a greater amount of silicon being burned off, so that the metal will no longer have the desired composition.

Since manganese and phosphorus must be present in only small quantities (Mn 0.2 per cent. and P 0.1 per cent.) in good quality malleable cast iron, the charge must be graded accordingly, iron that is low in both these elements being used exclusively. There is also a considerable loss of carbon, the quality of the metal being correspondingly improved. Table I. gives the analyses of a number of samples of (unannealed) malleable cast iron produced at the Killing Works: —

TABLE I.

Thickness of Casting.		Total Carbon. Per cent.	Si. Per cent.	Mn. Per cent.	P. Per cent.	S. Per cent.
No.	Mm.					
1	10	2.67	0.85	0.21	0.08	0.06
2	7	2.77	0.92	0.18	0.11	0.05
3	12	2.80	0.80	0.23	0.10	0.07
4	15	2.71	0.70	0.21	0.09	0.10
5	14	2.68	0.73	0.17	0.09	0.08
6	10	2.65	0.78	0.20	0.12	0.06
7	8	2.75	0.88	0.21	0.08	0.08
	20	2.60	0.65	0.20	0.10	0.10

These data show the trouble that has to be taken to apportion the silicon content of the various charges to the thickness of the castings to be made therefrom, whilst the proportions of manganese, phosphorus, and sulphur remain for the most part within permissible limits. In spite of the low carbon content, the castings all came out sharp, thus showing that the open-hearth furnace can produce hot, very fluid, iron.*

The following temperature determinations, made with a Wanner pyrometer, are of interest: —

TABLE II.

Charge.	Furnace temperature.	Iron temperature. Commencement of tapping.	End.
1	1,670°C.	1,275°C.	1,308°C.
2	1,650	1,350	1,380
3	1,590	1,290	1,375
4	1,600	1,275	1,290

Charge No. 4 was intended for thick castings, and had a composition corresponding to the samples 4 and 7 of Table I. This justifies the lower tapping heats in comparison with charges 1 and 2, which were for thin castings.

The old approved foundry rule to pour the metal as hot as possible, in order to obtain perfect, compact castings, must be specially borne in mind when working with metal low in carbon, in order to avoid defects and wasters. The amount of coal consumed averages 40 per cent. of the weight of the charge, without counting night coal.

At the works of Messrs. Killing a Poetter gas producer, with automatic fuel-feed, supplies heat to the annealing furnace, in addition to the open-hearth, the centralisation of the source of heat for both furnaces saving expense in working.

The Poetter annealing furnaces are fitted with regenerators, and arranged as low-level furnaces with detachable covers, which are lifted off by an electric travelling crane, which also lowers and removes the filled annealing pots.

In comparison with the old system of direct fire heating, the method of gas heating affords the undeniable advantage of enabling the temperature to be regulated exactly. In order to utilise this advantage, each furnace is equipped with a self-registering Braun pyrometer, so that the heating can be controlled throughout. When the temperature requisite for the production of temper carbon has been attained, the furnace must be maintained at a constant temperature of about 950 deg. C., for the purpose of oxidising the carbon. The heat of the waste gases is utilised in the recuperator, the temperature in the flue being comparatively low, viz., about 290 deg. C. Heating up to maximum temperature takes 15 hours, and this temperature is maintained for 30 hours, after which the furnace is cooled down during another 15 hours. Specimens of the tempered castings gave the following composition: —

TABLE III.

Total Carbon. Per cent.	Si. Per cent.	Mn. Per cent.	P. Per cent.	S. Per cent.
1.01	0.73	0.25	0.09	0.09
0.87	0.86	0.28	0.11	0.08
0.93	1.06	0.17	0.13	0.11
1.12	0.91	0.13	0 12	0.06
1.53	0.26	0.21	0.07	0.13
0 91	0.87	0.20	0.09	0.08
0.89	0.89	0.21	0.12	0.09

In nearly all cases the carbon content has been reduced to the permissible limit, but the percentage of sulphur shows an increase all round, owing to the sulphur in the tempering ore. The results of tensile tests on worked bars are given in Table IV.: —

TABLE IV.

Tensile strength. lbs. per sq. inch.	Elongation. Per cent.
46,500	3.9
47,500	4.1
44,200	4.3
48,600	3.5
45,000	4.5

The most noteworthy feature about these results is the relatively high elongation, which is unattainable in metal from the cupola furnace, and is very characteristic of the superiority of the open-hearth furnace for the production of malleable cast iron.

* These figures are however not so favourable, in a qualitative sense, as have often been obtained by others. Thus Ledebur found 2.34 per cent. C; 0.35 per cent. Si; 0.05 per cent. Mn; and 0.08 per cent. P in malleable cast iron from the open-hearth furnace, the tensile strength being 59,700 lbs. per square inch, and the elongation 4 to 5 per cent. The loss in the furnace was 8 per cent. The first Eckardt furnace for malleable cast iron was erected in 1882, and the results obtained were so satisfactory that 16 of these furnaces are now in operation, some of them producing 15 tons daily of molten iron for fittings and other commercial malleable castings. The furnace will also produce steel for very thin castings, one plant laid down last year making steel for motor car fittings. 350 to 400 castings per ton of metal, including 2-oz. spanners, 11 lb. bends, 3 inches wide and 15 inches long, and various tubes. The castings only required annealing to remove the casting stresses or increase the fineness of grain.

MESSRS. A. L. GIBSON & COMPANY have now started manufacturing their specialities at their new Radnor Works, Strawberry Vale, Twickenham. Their offices and warehouse continue at 19, 20, and 21, Tower Street, Upper St. Martin's Lane, London, W.C.

MOSES, EADON & SONS, LIMITED, President Steel Works, Sheffield, have appointed Mr. C. A. Hunton as their agent for London and the South of England, and Mr. J. A. Barton has been transferred from the South of England to the Northern Counties.

British Foundrymen's Association.

Annual Convention at Birmingham.

The programme has just been issued of the sixth annual convention of the above Association, which will be held at the University Buildings (late Mason's College), Edmund Street, Birmingham, on August 3, 4, and 5 next. The headquarters of the Association will be at the Imperial Hotel, Upper Temple Street, off New Street, Birmingham, where rooms have been secured for the sole use of the members.

The local reception committee includes the following well-known gentlemen connected with the foundry trades:—Mr. R. Buchanan (chairman), Prof. T. Turner, Mr. F. J. Cook, Mr. A. H. Hiorns, Mr. W. J. Foster, Mr. R. Mason, Mr. J. B. Tattersall, Mr. A. Fraser, Mr. M. Gale, Mr. W. L. Reason, Mr. J. Matthews, Mr. H. Winterton, Mr. G. Hailstone and Mr. C. Heggie (secretary).

The annual report of the Council for the year 1908 states that during the year a life honorary member, Sir Robert Hadfield (Bessemer Medallist), has been elected a Fellow of the Royal Society. The Sheffield branch secretary Mr. Thos. Swinden, has been awarded the Andrew Carnegie Research Scholarship, value £100, for original research in metallurgy, by the Iron and Steel Institute, also a premium from the Institute of Electrical Engineers for a paper on "The Magnetic Properties of Carbon-Tungsten Steels." The total numbers on the roll of the Association at the present time is 448, consisting of 6 life members, 39 honorary members, 311 members, and 92 branch associate members; which, as compared with 5 life, 29 honorary, 286 members, and 62 branch associate members the previous year, shows a net gain of 66. During the past year 4 honorary and 32 members have resigned, and 14 honorary, 61 members, and 30 branch associate members have been elected. The total revenue for the year was £138 12s., while the expenditure was £123 6s. 8½d., leaving a balance of revenue over expenditure of £15 5s. 3½d.; this, with the balance of £32 15s. 5½d. brought forward from year 1907, leaves a total balance in hand of £48 0s. 9d.

During the past year the Council have seriously considered the position of the Association, and, as a result, call attention to the following suggestions:—The Association was established purely on an educational basis. Conducted solely on these lines, the results up to date have been extremely successful. However, the time has now arrived to consider whether greater success is not within their reach. The Council consider that an opportunity is now presented of widening the organisation by attaining greater facilities, and in turn greater efficiency. Given these facilities, the printed proceedings could be enlarged in the following directions:—(*a*) Fuller reports of the discussions at the annual meetings; (*b*) the inclusion of papers read at branch meetings; (*c*) discussions at branch meetings; (*d*) abstracts of British, Continental, and American papers or researches relating to foundry practice.

These ideals cannot be attained without funds, and, as an illustration, the Council state that under existing conditions the present cost per member is 7s. 9½d. per year. In order to make some move towards increased efficiency, the Council tentatively suggest a scheme of membership as follows:—

Class.	Annual Subscription. £ s. d.
Members	1 1 0
Associate Members	0 10 6
Associates	0 3 0

Six members of the Council are retiring, three offer themselves for re-election, and Mr. Mason, owing to his being elected President of the Birmingham Branch, retains his seat as *ex-officio* member of the Council. The following gentlemen have been nominated to fill the vacancies:—Mr. W. J. Morris, Butterley Ironworks, Derby, works manager; Mr. C. Heggie (Secretary Birmingham Branch), foreman patternmaker, Messrs. J. W. Wright & Eagle Range Company, Aston; Mr. L. Graham, Messrs. Willans & Robinson, Rugby, foreman moulder; Mr. J. E. Stacey Jones, metallurgist in private practice, Coventry; Mr. W. F. Bagnall, Shalesmoor Foundry, Sheffield; Mr. W. J. Ellis, Messrs. Flack & Ellis, Southampton; Mr. C. Morehead, Messrs. Siemens Bros. & Company, Stafford.

We print herewith the current balance-sheet:—

Fifth Annual Balance Sheet, 1908.

INCOME.

January 1st to December 31st, 1908.

	£	s.	d.
Balance from 1907	32	15	5½
Arrears Subscriptions, 1907	1	10	0
Contributions: Members—			
32 Hon. at £1 1s.	33	12	0
276 Ord. Members at 7s. 6d.	103	10	0
	£171	7	5½

EXPENDITURE.

January 1st to December 31st, 1908.

	£	s.	d.
Postage	9	14	5½
Printing and Stationery	16	1	6
Council Expenses	7	13	2
Printing Annual Proceedings	34	2	8
Expenses Annual Meeting	8	0	6
Branch Expenses	9	19	1
Typewriter	5	10	0
Registration of Rules	7	9	6
Illuminated Address, Mr. Buchanan... ...	4	14	6
Secretary's Expenses	3	3	6
Clerical Assistance	2	2	0
Cheque Book	0	2	6
Stamp	0	1	4
Arrears Sub., 38 at 7s. 6d.	14	5	0
Cash in Treasurer's hand	0	4	9
Cash in London City and Midland Bank ...	47	16	0
	£171	7	5½

Audited and found correct,
H. PILKINGTON.
J. E. CROWTHER.
F. W. FINCH, Treasurer.
J. E. H. ALLBUT, Secretary.

Programme.

The following is the programme of the forthcoming annual meeting in detail:—

TUESDAY, AUGUST 3.

9 a.m., election of officers; 10 a.m., municipal reception by the Lord Mayor of Birmingham; Presidential Address. Papers: "Twenty-five Years of Cast Iron," by Prof. T. Turner, Birmingham; "The Production of Patterns for Light Castings," by Mr. W. H. Sherburn, Warrington; 2.30 p.m., visit to the new buildings of the University, Birmingham. [The buildings and grounds of the University cover an area of 44 acres, kindly presented to the authorities by Lord Calthorpe. Prof. Turner was appointed the first Professor of Metallurgy, and the new metallurgical department, which has now been in working order upwards of four years, was designed and equipped under his superintendence. The engineering department supplies, direct from the power station, direct

and three-phase electric current, and Mond gas, for use in metallurgical laboratories. The University contains smelting laboratories, gas plant, foundry, forge, Siemens furnace with necessary electric hoist, crane, boiler, ladles, moulds, and stores for metals, ore, and furnace materials, also a water jacketted blast furnace, a roasting furnace, cupellation furnace, Bruckner calciner, weighing machine, and Root's blower.] 7.45 p.m., visit to municipal tramway generating station, Summer Lane, Birmingham.

WEDNESDAY, AUGUST 4.

9.30 a.m., Papers: "Influence of Chemical Compounds on the Properties of Cast Iron," by Mr. A. H. Hiorns, Principal of the Metallurgical Section, Birmingham Technical School; "The Application of Rule-of-Thumb and Science in the Foundry," by Mr. Sydney G. Smith, Chesterfield; "Introduction to the Effect of Structure upon the Physical Properties of Cast Iron," by Mr. F. J. Cook and Mr. G. Hailstone, Birmingham; 2.30 p.m., visit to Messrs. Belliss & Morcom's electrical machinery department, Icknield Square, Birmingham; 7.30 p.m., smoking concert in the Temple Room at headquarters, Imperial Hotel, Temple Street.

THURSDAY, AUGUST 5.

Visit to the British Thomson-Houston, Limited, Rugby, to inspect steam turbine and general electrical engineering works: to be followed by picnic.

Some American Moulding Machines.

(*Continued from page* 431.)

The "Modern" Machine.

The machine, made by the Arcade Manufacturing Company, of Freeport, Ill., U.S.A., and styled the "Modern," is designed for handling moulds for light castings, such as are usually made in flasks 14 in. by 22 in., or less, and is, we understand, in successful operation in brass, malleable iron, and grey iron foundries, doing a great variety of work.

FIG. 7.—TABLE HOLDING PLATE TURNED FACE UP AND TWO HALVES OF FLASK ATTACHED.

The patterns used are in the form of match-plates, or split patterns, the cope and drag halves of the mould being thus produced at the same time. The plates are usually made from regular gated metal patterns. White metal is used in making the plates, and this is bedded in heavy cast-iron frames, giving a plate that is particularly serviceable.

The machine is simple in operation, and can be readily mastered by an inexperienced workman. The pattern-plates attached to the revolving tables are shown in Fig. 10. In the beginning of the operation the table holding the plates is turned face up, with the two halves of the flask attached. After the sand has been thrown in the flask the cope and bottom boards are placed in position and held by two clamps. The table is rolled over and pressure applied to the sand by means of a long lever at the left of the machine. This releases the clamps automatically, and the pattern is drawn by gradually allowing the lever to resume its normal position and by vibrating the pattern at the same time.

FIG. 8.—TABLE ROLLED OVER.

The mould now rests on a sliding platform, which is drawn forward to a convenient position, and the mould is then closed. The operations of the machine are depicted in Figs. 7, 8, 9, and 10. The machine, which is mounted on wheels, allowing the moulder to move on as the number of moulds increases, is 34 in. high, 49 in. long, and 42 in. wide, outside of wheels, the weight being 1,200 lbs.

For the accommodation of larger work the Arcade Manufacturing Company have also constructed a larger variety of their machine, on which may be handled flasks having dimensions up to 12 in. by 30 in. if the patterns are attached as shown in Fig. 10, or 16 in. by 24 in. placed side by side. Either wood

or iron flasks may be used. The range of work done on this machine is considerable, a casting weighing 75 lbs. having been successfully produced on it. By means of adjustable balance weights, moulds are made with the same ease and speed as with the machine previously described.

FIG. 9.—DRAWING THE PATTERN.

The Berkshire Machine.

The Berkshire moulding machine, constructed by the Berkshire Manufacturing Company, Cleveland, O., U.S.A., who are represented in this country by Messrs. J. W. Jackman & Company, Limited, Caxton House, Westminster, comprises a sand-screening apparatus, a moulding machine and mechanism for elevating the sand and filling it into the flask. A general view of the entire apparatus is presented in Fig. 11. The operation of the mechanism is in detail as follows:—The flask and bottom board having been put into position and the lever thrown, the sand is sifted in the riddle at the rear of the machine, and then conveyed in a bucket elevator to the hopper above. The flask is next automatically carried to the rear, where it is filled with sand. It then travels forward and is met in its course by the bottom board supported upon the ram, which is forced down, thereby ramming the sand. At the same time the vibrator is automatically thrown into action, which makes impossible the formation of any vacuum, and also prevents the sand from adhering to the pattern. While the flask returns to receive its supply of sand, the bottom board is supported by suitable hooks, but as the ram comes down these hooks are drawn back so that the board remains upon the mould. The operator then lifts off the flask and sets it to one side, blows the sand from the table with an air hose and all is ready for placing the other half of the mould. The pressure of the ram upon the sand can be quickly adjusted, and it is also possible to adjust the boards in such a way that the drag will be rammed harder than the cope. The pattern plates are placed in an ordinary

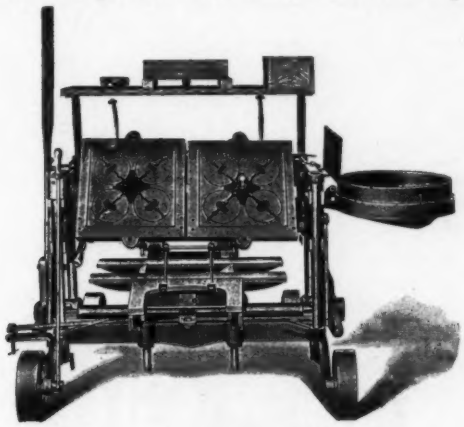


FIG. 10.—PATTERNS ATTACHED TO REVOLVING TABLE.

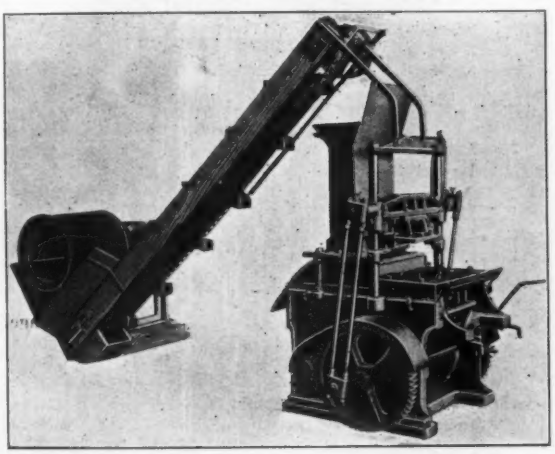


FIG. 11.—THE BERKSHIRE MOULDING MACHINE AND SAND CONVEYOR COMPLETE.

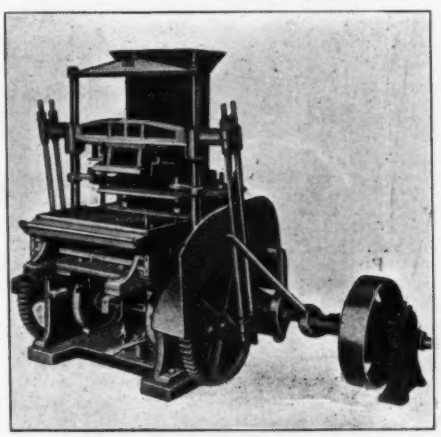


FIG. 12.—THE IMPROVED BERKSHIRE MACHINE.

table, or platen, at the front of the machine, and can be changed by removing four screws which hold the plate in position, and slipping in the new plate. The plates are accurately located by dowel pins. Split patterns plated on one side of a cast-iron plate, are employed.

One of the features of this machine is the heating of the pattern plates by gas jets from beneath, so that the moulds draw readily, without the use of any parting material whatever. By this method, with the proper grade of moulding sand, very fine work is made possible without any facing.

The Berkshire machine has been on the market for some years now, and various improvements in it have been effected. Amongst recent ones may be mentioned the attachment of a foot lever for starting and stopping. This replaces the hand lever which in the earlier pattern of this machine engaged a clutch in the driving wheel. When the foot lever is depressed it releases a catch and permits the machine to make one complete revolution, thereby making one-half the mould. By the use of the foot lever, the operator is not compelled to leave the front of his machine, and considerable time is gained by this arrangement. A pneumatic device has also been attached for lifting the flask pins. The lever for this device is thrown by the operator's knee. In the earlier machines a hand lever was used to release the flask pins, which would drop as the machine carried back the flasks. Improvements have also been made with the vibrator, the operation of which begins when the flask starts under the sand hopper, its period of operation being controlled by a cam on the auxiliary shaft. Increasing the time of the vibrator operation results in jarring down the sand more effectively into all the pockets of the patterns. The vibrator continues to operate until the pattern is lifted from the pattern plate. The time of vibration is regulated by the cam, and it can be stopped when the mould just clears the plate or continued until the flask has been raised to its full height. The speed of raising the flask is controlled by a valve so that it can be lifted rapidly or slowly, according to the nature of the work. The air cylinder can also be used for drawing the patterns down through a stripping plate if necessary. Another feature is the positive stop which centres the flask under the ramming head. This effectively prevents the ramming of the sprue out of place.

Fig. 12 shows the modern Berkshire machine with the improvements mentioned.

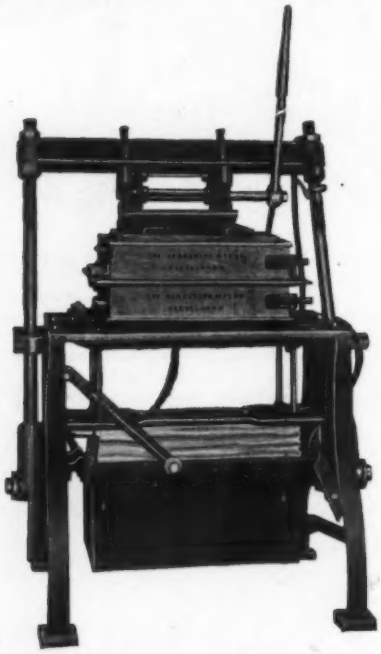


FIG. 13.—FLASK FILLED WITH SAND; MATCH PLATE BETWEEN COPE AND DRAG. THE RAMMING HEAD IS TILTED BACK.

The Berkshire Hand Squeezer Machine.

The Berkshire Manufacturing Company also produce a combination hand squeezer and pattern drawing machine. This apparatus is designed to take the place of the automatic moulding machine just described, where the output of the different castings is limited and the foundryman does not desire to change the patterns to meet the requirements of that apparatus.

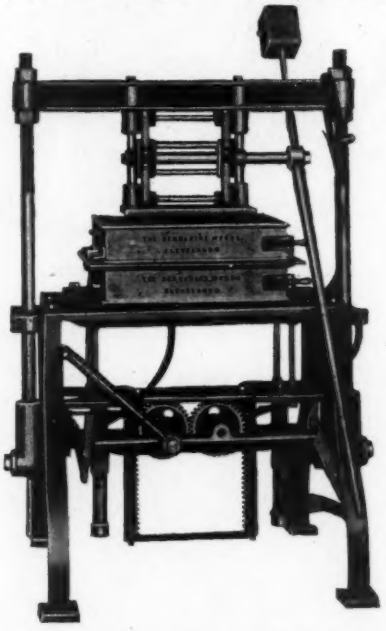


FIG. 14.—RAMMING HEAD TILTED FORWARD AND MOULD RAMMED BY DOWNWARD STROKE OF SQUEEZING LEVER.

The squeezer machine we illustrate in Figs. 13-16. The mechanism of the flask-lifting posts, which are raised when the pattern is being drawn and the cope flask is being lifted away from the pattern, is controlled by the lever at the side, which is thrown over by the operator while vibrating the pattern with a knee valve.

The post-raising lever is held until released by a spring catch. The four posts are attached to a slotted cast-iron frame, which permits of their adjustment to pattern plates, match plates and flasks of various sizes. The frame to which the posts are attached is operated by gears running in side racks, and as an additional precaution this frame is supported by guide posts at either end, operating in long bearings provided with oil reservoirs, which can be filled with-

out removing the sheet steel case shown in Fig. 13.

The operating parts beneath the table are enclosed by a canvas case between the centre frame and the table, and a sheet steel case is located underneath the middle frame, enclosing the oil reservoirs and the bearings of the guides of the centre frame. For cleaning the patterns, a blow-off is provided.

The various operations necessary for making a complete mould with one stroke of the squeezing lever are consecutively shown in Figs. 13, 14, and 15. In Fig. 13 the match plate with patterns on opposite sides is shown between the cope and drag halves of a snap flask, which has been filled with sand, the bottom and cope boards being in position. In Fig. 14 the head has been tilted forward in a vertical position over the flask, and the mould has been rammed by the downward stroke of the squeezing lever, which actuates the ramming head. In Fig. 15 the pattern

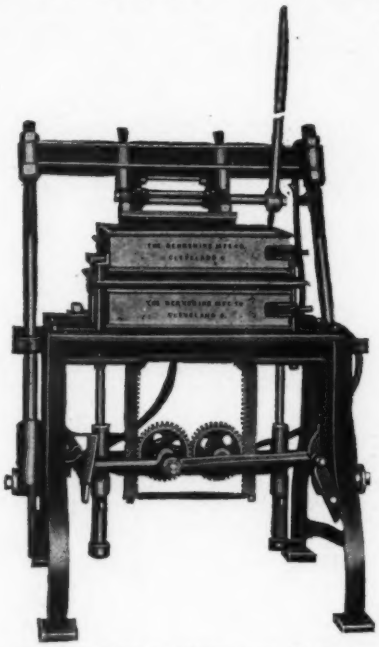


FIG. 15.—PATTERN-DRAWING AND FLASK-LIFTING POSTS RAISED, WITHDRAWING MATCH PLATE FROM COPE AND DRAG.

and flask-lifting lever has been swung over, thereby raising the four posts, and the match plate has been lifted from the drag mould by the lugs on the posts while the ends of the latter in contact with the lugs on the cope half of the snap flask, have lifted the same away from the upper side of the match plate. The cope is then lifted off, the match plate is removed. The mould is then closed and the flask removed.

The use of a pattern plate with split patterns on one side is illustrated in Fig. 16. The plate is bolted to the table, the flask set in position, filled with sand and with the bottom board in place is rammed as previously described. After tilting back the head the mould is lifted away from the patterns by the four posts as shown. When using a sand match with movable patterns, the match plate is placed on the table, the flask is set on the same and the mould is rammed. After tilting back the head, the mould, together with the sand match is rolled over, and the match board is lifted away from the drag by the four lifting posts which engage lugs on the ends of the frame of the match board. The patterns are left in the sand, the cope flasks adjusted, filled with sand and rammed. The cope flask is then lifted away from the patterns, and after they have been withdrawn from the sand the mould is closed.

The machine consists of a cast-iron table to the frame of which is attached the pattern drawing mechanism. The tilting, ramming head is attached to a cast-iron cross-bar supported on shafts fastened to the frame. The table is slotted to permit of the passage of the pattern and flask-lifting posts, and slots are also provided for the adjustment of the flask stops, which can be set for any flask within the capacity of the machine.

A compound toggle movement reduces to a minimum the power required to ram the mould, and as the toggles are self-releasing, it is impossible to ram

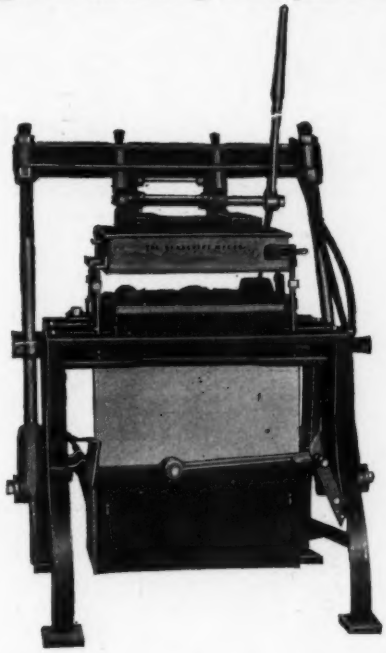


FIG. 16.—ILLUSTRATING USE OF A PATTERN PLATE WITH SPLIT PATTERNS ON ONE SIDE.

a mould harder than the density desired after the head has been adjusted for the pattern to be moulded. The head is adjustable up and down, this being controlled by nuts on the two steel uprights. The squeezing lever is of sufficient length to be operated without great exertion, and is counterbalanced at one end with an adjustable weight. The tilting of the head is controlled by springs attached to the lower ends of the steel uprights and the frame of the machine.

(To be continued.)

ON Thursday, July 8, an outbreak of fire—the second within a month—took place in the pattern shed at the Ferryhill Foundry, Aberdeen, belonging to Messrs. James Abernethy & Company. The flames were soon extinguished, but not before a large number of patterns had been destroyed.

A Difficulty in Cylinder Casting.

At a meeting of the Birmingham Metallurgical Society, held at the Municipal Technical School on June 17, Mr. A. H. Hiorns presiding, a short paper was read by Mr. A. Jude on "Peculiarity in a Cylinder Casting."

Mr. Jude exhibited a drawing of a cylinder which, some time ago, he had occasion to examine rather minutely, and in which he found the peculiarity in question. The cylinder was of the type used in a certain make of high-speed electric light engines, the high-pressure and the low-pressure cylinders being made, with steamchest common to both between, in one casting. In the larger type of cylinders of this class there is a considerable amount of metal in and about the valve chest, frequently distributed in unequal thicknesses. The cores also are frequently very large in area, but have narrow spaces from which the air has to pass when the casting is being made. There is therefore retained in this part of the cylinder a greater amount of heat than is the case in the barrels. Mr. Jude explained that he had occasion to examine a casting of this type in order to find out what differences were caused in various parts owing to the different thicknesses and other special conditions mentioned. Tests were taken from three places in the casting and subjected to analysis and tensile tests, with the following results:—

	C.C.	G.C.	Si.	S.	P.	Mn.	Tensile strength.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
A	0.207	2.847	2.47	0.144	0.951	0.34	9.69
B	0.227	2.903	2.38	0.131	0 951	0.28	9.00
C	0.607	2.574	2.33	0.129	0.906	0.36	10.95

What Mr. Jude particularly wished, however, to draw attention to was the formation in one part of the casting of a peculiar dark streak, observable when the metal was examined under the microscope. The thickness of the metal at this part of the casting was about $\frac{3}{8}$ in., and the streak appeared at a distance of about $\frac{3}{16}$ in., from the surface which had been adjacent to the mould. He put forward as a tentative reason for the appearance of this shell-like form, that a kind of annealing process took place at this part. First of all a hard skin was formed by the sudden cooling which the metal received from the mould and cores; afterwards the heat absorbed by the mould and cores caused, as it was given up again, an annealing action on the parts of the casting adjacent to them. As the casting was in this way kept below the critical temperature of the solidification of ferrite, the metal would receive a kind of annealing, local all round at the surface, which would readily change the combined carbon into the graphitic form.

Mr. F. Thomas thought that there were one or two deductions to be made from the analyses given by Mr. Jude. It would be seen that the greatest tensile strength was associated with the analysis that had the least proportion of impurities. Therefore he thought Mr. Jude would be right in saying that the differences in strength were due to the differences in the purity of the iron. There was much yet to be ascertained about the effect of varying proportions of the different elements. Most experiments up to now, such as those of Professor Turner, had been made with variations of one element only, and thus very little was known about the effects of variation in the whole of the different elements.

Mr. F. J. Cook (President of the British Foundrymen's Association), remarked that while Mr. Thomas took the line that the physical properties of cast iron depended solely on the chemical constituents, his own experience was that the same strength could be got with totally different compositions, and different strengths with the same compositions. The rate of cooling had far more to do with the strength of cast-iron than had the chemical composition. One could have a greater range in difference of composition than one could have in rates of cooling without corresponding variations in the strength. The part of the cylinder in question was adjacent to very large cores, which retained a great deal of heat for a very long period. The peculiar line mentioned by Mr. Jude was farthest away from this core, and that, to him, showed that the heat it contained had had considerable effect on the structure. Where a large area of sand was present to carry away the heat there had been very little annealing effect; thus the peculiar streak was nearer that part, as explained by Mr. Jude.

Mr. Jude, replying to Mr. Thomas's remarks, said that he was afraid they would never get an equation which should represent the variations of all the elements in cast iron or in any other metal. They all knew the difficulty of a problem in three dimensions, and when they came to six or seven there was little hope of getting a workable formula. They might get an inkling of the dependence of one element upon one, two or three others, but he had no hope of their getting much farther. He agreed with Mr. Thomas to some extent as to the influence of chemical constitution on the strength of cast iron, but he was inclined to support more strongly the view of Mr. Cook, namely, that larger variations were caused by differences in the rate of cooling. As to comparison between the tensile tests and the chemical analysis, it should be remembered that while the chemical analysis was made from a comparatively small area, the tensile test was applied to a comparatively large bar. The metal in the middle part of the cylinder was soft, whereas the barrels were hard. This pointed to different rates of cooling.

Mr. Thomas explained that the view he took was that the influence of difference in the rate of cooling was very largely affected by differences in the chemical composition.

Mr. Buchanan, in seconding the vote of thanks which the President had proposed to the reader of the paper, added that it was not at all an uncommon thing for a casting to be ruptured owing to the core expanding while the casting was contracting, and some moulders trusted to the expansion of the core to supply pressure instead of feeding with the rod. Whether or not that was the solution of the problem, he could not say; but it was a well known phenomenon.

Furnace Arches.

Mr. F. Lane read a paper on "Furnace Arches and Furnace Door Arches." By means of models he illustrated the principal causes of failure, and pointed out that a soffited arch was, as a rule, more stable than a free arch. It was particularly important, especially in the latter case that every springer should be perfectly normal to the curve of the arch.

In the selection of bricks the structure should be sufficiently hard to resist changes of temperature, and fine enough to resist the crushing strain.

The President, in thanking Mr. Lane for his paper, remarked that it illustrated in various ways how much often depended upon comparatively little things.

Mr. F. Thomas said that firebricks which resisted heat best were the most brittle. Therefore a difficulty seemed to arise when great strength combined with exposure to great heat was required in the arch.

Mr. Rees (Hon. Secretary) asked Mr. Thomas for evidence of the fact that the brick which was most resistant to heat was the weakest mechanically.

Mr. Thomas: It must have a greater percentage of silica and less binding material. Obviously, then, it is less strong.

Mr. Lane, in reply, said that it did not always follow that the brick which was best suited to resist high temperatures was the softest brick. They could make a brick very hard out of the same clay by altering the texture. They could make a brick finer, and that brick while being harder—more dense—would not be so suitable to resisting fluctuations of temperature. But the same clay, under both conditions, if the heat was not fluctuating, would serve the purpose very well.

Gas-Heated Furnaces.

In construction, and in the methods of obtaining high-temperature efficiency, the furnaces which we illustrate herewith represent a distinct departure from the lines generally followed. The furnaces are heated by a combination of coal-gas and hot air, and are designed for laboratory and workshop use.

Reference to Fig. 1, which presents a sectional diagram of a crucible furnace, will show that the

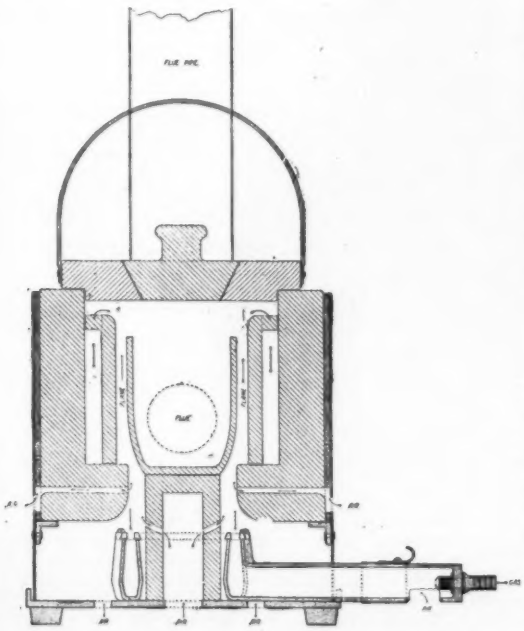


FIG. 1.—GAS HEATED CRUCIBLE FURNACE.

secondary air is drawn into the furnace in such a was as to serve two distinct purposes. The air is first heated in its passage before mingling with the bunsen flame, and, second, the points of admission are so arranged as to materially assist the up-draught from the burner. A novel form of bunsen burner is employed; it is so shaped as to emit separated tongues of elongated flame and extract the utmost duty from the secondary air, this tending to a speedy heating of the furnace. The burner is entirely of cast iron, free from gauze, easily kept clean, and practically indestructible. It is also fitted with an air regulator, adjustable *in situ*, and except for the largest sizes of furnace the one burner is sufficient. These furnaces range in capacity from 2 lbs. to 36 lbs., according to size, when used for brass. The consumption of gas per hour, at $\frac{1}{10}$ths pressure, is stated to be 40 cubic feet for the 2-lb. size, 55 cubic feet for the 6-lb. size, 70 cubic feet for the 12-lb. size, 85 cubic feet for the 24-lb. and also for the 36-lb. size. These furnaces give a heat up to 1,300 degrees Centigrade, and it is claimed that half-an-hour after lighting up a serviceable heat is obtained.

Fig. 2 shows a muffle furnace constructed on the same principle as the foregoing, for assaying, annealing, hardening, and other laboratory and works' purposes. The ease of control which is a feature of the crucible furnace is also associated with the muffle furnace, and the loss of heat by radiation is reduced to the minimum. Another form of muffle furnace, designed on the same principle for laboratory and similar work, is shown in Fig. 3, (page 473).

The makers of these furnaces are the Richmond Gas Stove and Meter Company, Limited, whose works are at Warrington, and to whom we are indebted for the foregoing particulars.

THE retirement is announced of Mr. William Herbutt, after some 40 years' experience, of the Sheffield steel trade, mostly in the capacity of Inspector for Colonial Governments. The event was recently signalised very pleasantly by a dinner at the Royal Victoria Hotel, Sheffield, to which he was entertained by his fellow-inspectors and representatives of practically all the steel-making firms of the city. A native of Rutland, Mr. Herbutt served for some years in the engineering department of the Great Northern Railway, at Doncaster, and then went to the Parkgate Company, at the time that the first armour-plates were rolled in this country. Then he was with Messrs. W. & S. Butchers, Rutland Works (now Messrs. Samuel Osborn & Company), where the first welded steel tyres were rolled. He was afterwards engaged as the Sheffield representative of Messrs. Naylor, Benzon & Company, at that time the leading London steel rail merchants. Then he left Sheffield for a short time, to go to South Wales, and subsequently returned to Sheffield as engineer-inspector of railway material for the Queensland Government, a position he held for some 23 years. He then represented the Cape Government in a similar capacity, till his recent retirement, latterly assuming a like responsibility in the interests of the Chinese Imperial Railways. Mr. Herbutt was made the recipient of presentations from numerous friends.

Continuous Melting with the Ordinary Cupola.

By Walter J. May.

For many purposes, and especially for light work it is an advantage to have metal from about 9 a.m., until work ceases, and while this can be readily managed it necessitates certain alterations to the cupola as generally existing, while a somewhat different system of management also becomes necessary.

Considerable economies can be made in the production of castings by continuous melting, especially where the whole of the work is done in flasks carrying moulds for castings up to about 2 cwt. each as a maximum, as the moulding can be done practically close to the cupola, and thus save a lot of metal carrying. Besides this, the amount of floor space needed for a given weight of work is much lessened, because with a methodic arrangement of the flasks the ground can be worked over two or three times daily if necessary, and the moulding allows of quick working. In the case of cored work it follows that the cores must be ready in anticipation of the moulds.

Two cupolas should be provided, and these should be run on alternate days to allow time for fettling the one out of use, as otherwise comparatively long periods will be necessary for mending and patching. A continued heat for at least nine hours at each melt necessarily injures the lining more than when only comparatively short periods of heat have to be resisted. With ordinary care, however, the linings will not wear unduly, and it is only where neglect takes place that undue wear has to be dealt with.

In the original bricking up of the cupola for this class of work there should be two rings of brickwork, the outer one being of the ordinary segment bricks or the usual lining blocks set with a space of from half an inch to an inch between the brick and the iron shell, this space being filled with dry sand or fireclay as is most convenient, while the inner lining should be of arch bricks set on end with a couple of vertical courses of rectangular bricks to allow of easy removal of parts of the ring, should partial renewals be found necessary at any time. The internal diameter of the cupola should be from 16 to 20 in. when first lined, but this size increases with wear, as at least two-thirds of the inner lining can be worn away before it is necessary to renew the brick lining. Patching with ganister will be necessary from time to time, the same as in the ordinary practice, the best grade of ganister being that which is finely ground as for steel furnace work; this, while being rather more expensive than the roughly ground material generally used, does not eventually cost more than the cheapest material.

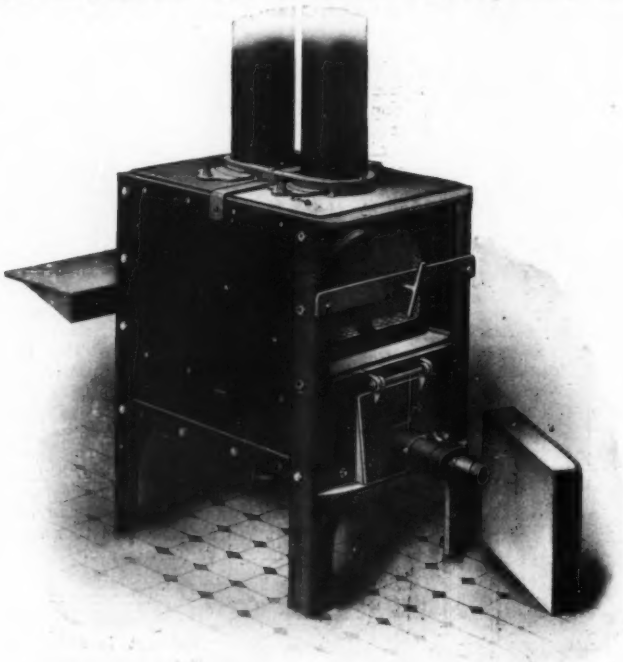


Fig. 2.—Rear View of Gas-heated Muffle Furnace.

It does not matter whether the cupola has an air belt or is blown with a couple of tuyeres direct from the air main, but the tuyeres should be of large enough area, and the wind supply of sufficient power to supply air in large quantities at a low pressure. The fuel necessarily requires sufficient oxygen to maintain a sufficiently high state of combustion, otherwise the metal will not melt. But while this is the case it is not required to use abnormal quantities of coke to bring down iron in a fluid state: in fact, from 8 to 12 lbs. of hard Durham coke should be sufficient for each 1 cwt. of iron after the bed is in, some differences being caused by local conditions in the case of each

cupola. Scarcely any two cupolas work exactly alike, even when apparently similar in every respect. Theoretically this should not be the case, but in practice it is so, and often the difference is caused by small details which are extremely difficult to get at.

With continuous melting slag accumulates, and has to be removed, this rendering the provision of a slag-hole necessary. The top of this should be level with the bottom of the lowest tuyere, and it should be made up in the same way as the tap-hole for the metal except that it should be filled with poor, black floor-sand until it becomes necessary to remove slag. As usually the slag rapidly cuts away the iron shell of the cupola if it runs down it, the provision of a short spout is rather a necessity, this being lined in the same way as the tapping spout for metal. If the slag runs down the bare metal of the spout that will be burned away, but such a thing would scarcely be permitted where the cupola man knows his business.

In working the cupola is started in the usual way, and the metal is tapped off when ready, small charges of about 3 cwt. being used. In charging the cupola each charge should be put on as the preceding one falls, the charging like the tapping being continuous, and a sufficient amount of chalk or limestone should be charged to keep the slag fluid, but no excess of this material should be used or the furnace lining will be unduly cut away, and this to no purpose. Just before the dinner interval the whole of the metal should be blown down—charging, of course, having ceased—and the whole tapped off as clean as possible. Several baskets of coke should then be put in, the blast being stopped, and the furnace will stand quite safely for the hour. On restarting, the bed must be made up, a charge put in, and the furnace restarted as with a new furnace, blast being put on gradually. The after-work then goes on in the usual way.

Owing to the length of time melting is kept up there is often the chance of losing the coke bed, and to guard against this it is desirable to throw in some pieces of the hardest coke of a size larger than that used in the ordinary charging. If, however, the bed is lost there is only one remedy, that being to at once draw the furnace. If this is not done very considerable trouble will result. One experience of a cupola which has, to use an inelegant although very expressive phrase, "got bunged up" with partly-fused metal, slag and coke, through losing the bed and the charge getting below the melting zone, usually is sufficient to last a lifetime with most persons. But still, from want of attention, or at times through some unforeseen cause, such a thing does occasionally occur.

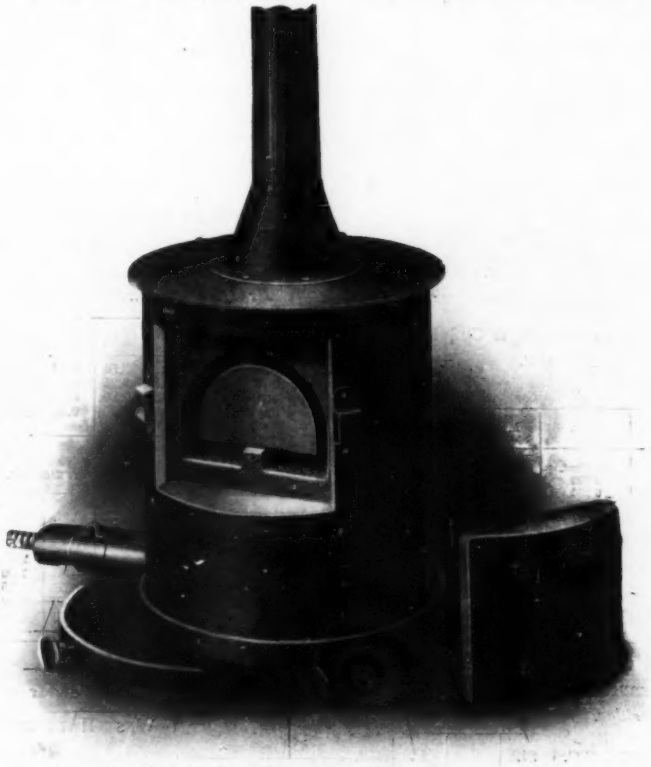


FIG. 3.—REAR VIEW OF A LABORATORY MUFFLE FURNACE.

Usually where a cupola man has only been used to the ordinary short melts he requires some coaching to get him into the continuous system, and where this is the case someone should be employed to put him on the right lines, but after, say, a week's instruction, he should be able to manage for himself. Really, the only thing to learn is how to get down, say, five tons of metal, or perhaps less, in nine hours, instead of getting the same weight down in an hour or a trifle longer, a small instead of a large cupola being used in the operation. The only trouble is to keep the bed in good form, the furnace clean, and to remove slag as soon as it gets in the way.

D

Analyses of British Pig-Irons.

Supplementary to Analyses published in Previous Issues.

In our issues of August and October 1907, and January 1908, we published an extensive series of analyses of pig-irons produced by British makers. Since then we have received notice of various alterations in the analyses and therefore present herewith such tables as have required revision. We also give tables showing typical analyses of irons produced in the different districts.

CUMBERLAND

Harrington Iron and Coal Co , Ltd ,
HARRINGTON, CUMBERLAND.

Brand—"Harrington."

	G.C.	C.C.	Si.	S.	P.	Mn.
Hematite—						
No. 1 ...	—	—	2.00-3.00	tr. to 0.025	0.04	0.14
„ 2 ...	—	—	1.80-2.80	0.015-0.035	0.04	0.14
„ 3 ...	—	—	1.75-2.50	0.045-0.050	0.04	0.14
„ 4 ...	—	—	1.24	0.075	0.04	0.14

Messrs. Harrison, Ainslie & Co., Ltd.,
ULVERSTONE.

Brand—"Lorn."

	Grey.	Mottled.	White.
	Per Cent.	Per Cent.	Per Cent.
Silicon	0·822	0·580	0·118
Carbon	0·350	1·600	3·820
Graphite	2·230	1·220	0·100
Sulphur	0·007	0·004	0·004
Phosphorus	0·061	0·060	0·050
Manganese	0·216	0·050	0·180

DERBYSHIRE.

Sheepbridge Coal and Iron Co., Ltd.,
CHESTERFIELD, DERBYSHIRE.

Brand—"Sheepbridge."

	G.C.	C.C.	Si.	S.	P.	Mn.
No 1 Foundry ...	2.74	0.08	3.17	0.01	1.40	0.99
„ 2 „ ...	3.50	0.12	3.20	0.02	1.43	0.93
„ 3 „ ...	3.25	0.24	2.80	0.03	1.44	1.00
„ 4 „ ...	3.10	0.30	2 68	0.01	1.44	1.00
„ 4 Forge ...	2.80	0.60	2.10	0.06	1.45	0.98

Staveley Coal and Iron Co., Ltd.,
STAVELEY WORKS, NR. CHESTERFIELD.

Brand—"Staveley."

	G.C.	C.C.	Si.	S.	P.	Mn.
No. 1 Foundry ...	3.03	0.60	2.70	0.02	1.35	1.09
„ 2 „ ...	3.00	0.33	2.65	0.03	1.38	0.98
„ 3 „ ...	2.90	0.40	2.70	0.05	1.40	0.85
„ 4 „ ...	2.80	0.50	2.31	0 06	1.45	0.80
„ 4 Grey Forge	2.75	0.56	2.19	0.07	1.45	0.78
„ 4 Forge ...	2.60	0.60	1.90	0.09	1.45	0.75
„ 4 Close Forge	2.50	0.70	1.74	0.13	1.45	0.63
Mottled	1.10	1.98	0.85	0.20	1.43	0.54
White	Nil.	2.32	0.51	0.40	1.27	0.48

DURHAM.

Bell Bros., Ltd.
CLARENCE IRON WORKS, MIDDLESBROUGH.

Brand—"Clarence."

	G.C.	C.C.	Si.	S.	P.	Mn.
No. 1 Foundry ...	3.30	0.15	2.90	0.030	1.52	0.60
„ 3 „ ...	3.40	0.18	2.50	0.035	1.52	0.60
„ 4 „ ...	3.00	0.48	2.31	0.075	1.55	0.50
„ 4 Forge ...	2.90	0.62	1.53	0.142	1.50	0.45
Mottled	2.50	0.87	1.31	0.153	1.50	0.33
White	trace	3.10	0.93	0.250	1.52	0.30
Silicious	3.30	trace	4.22	0.016	1.55	0.70

Palmer's Shipbuilding and Iron Co., Ltd ,
JARROW-ON-TYNE, DURHAM.

Brand—"Jarrow," Cleveland.

	G.C.	C.C.	Si.	S.	P.	Mn.
No. 1	3.65	0.10	3.00	0.020	1.200	0.55
„ 3	3.25	0.30	2.50	0.060	1.200	0.50
Foundry ...	2.90	0.50	2.00	0.070	1.200	0.40
Forge	2.90	0.56	1.50	0.080	1.250	0.40

Brand—"Tyneside," Hematite.

	G.C.	C.C.	Si.	S.	P.	Mn.
No 1 Foundry ...	3.95	0.15	2.50	0.030	0.050	1.50
„ 2 „ ...	3.75	0.27	2.25	0.040	0.050	1.40
„ 3 „ ...	3.45	0.35	1.50	0.070	0.050	1.30
„ 4 „ ...	3.10	0.55	1.15	0.090	0.050	1.00
Mottled	2.00	1.50	0.80	0.10	0.054	0.80
White	0.40	3.50	0.50	0.20	0.055	0.60

The Seaton Carew Iron Co., Ltd.,
WEST HARTLEPOOL.

Brand—"Seaton Carew."

	G.C.	C.C.	Si.	S.	P.	Mn.
Hematite—						
Special	3.85	0.35	2.00	0.02	0.03	1.75
Ordinary ...	3.70	0.45	2.50	0.03	0.04	1.25

William Whitwell & Co., Ltd.,
THORNABY IRON WORKS, STOCKTON-ON-TEES.

Brand—"Thornaby Hematite."

	G.C.	C.C.	Si.	S.	P.	Mn.
No. 1	4.00	0.10	2.50	0.02	0.04	1.00
„ 2	3.85	0.15	2.40	0.03	0.04	0.90
„ 3	3.65	0.30	2.00	0.05	0.04	0.80
„ 4	2.80	0.60	1.50	0.10	0.04	0.65

Brand—"Thornaby."

	No. 1. Bessemer Thornaby Hæmatite.	No. 2 Bessemer.	No. 3 Bessemer.	No. 3 Foundry.	No. 4.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Graphite . .	3·900	3·620	3·620	3·365	2·960
Combined carbon .	0·100	0·140	0·210	0·310	0·660
Manganese . .	1·063	1·009	0·950	0·750	0·675
Silicon . . .	2·800	2·745	2·385	1·770	1·480
Sulphur . . .	0·026	0·033	0·045	0·055	0·110
Phosphorus . .	0·040	0·040	0·040	0·040	0·040
Iron . . .	92·070	92·230	92·740	93·710	94·175

	No. 1 Siemens.	No. 2 Siemens.	No. 3 Siemens.	No. 4	"Centred" Forge.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Graphite . .	4·053	4·065	3·750	3·250	2·745
Combined carbon .	0·100	0·180	0·220	0·450	0·680
Manganese . .	1·058	0·950	0·895	0·700	0·635
Silicon . . .	2·250	2·006	1·773	1·545	1·350
Sulphur . . .	0·025	0·030	0·040	0·070	0·120
Phosphorus . .	0·040	0·040	0·040	0·040	0·040
Iron . . .	92·477	92·789	93·282	93·945	94·430

Wigan Coal and Iron Co., Ltd.,

WIGAN.

Brand—"K.H."

	G.C.	C.C.	Si.	S.	P.	Mn.
Foundry	2.20	0.80	2.80	0.06	0.75	2.00
Forge	1.30	1.70	1.80	0.07	0.80	1.80
Ferro manganese	—	7.00	0.50	tr.	0.25	80.50
Spiegeleisen ...	—	5.17	0.60	,,	0.06	20.60
Silico Spiegeleisen	—	2.10 10 17		,,	0.07	20.00

LEICESTERSHIRE.

Holwell Iron Co., Ltd.,

ASFORDBY, NR. MELTON MOWBRAY.

Brand—"Holwell."

	G.C.	C.C.	Si.	S.	P.	Mn.
No. 1 Foundry ...	3.550	0.280	3.359	0.022	1.206	0.445
,, 2 ,, ...	3.500	0.290	3.313	0.025	1.190	0.431
,, 3 ,, ...	3.300	0.320	2.946	0.033	1.255	0.403
,, 4 ,, ...	3.190	0.350	2.893	0.031	1.271	0.403
,, 4 Forge ...	2.800	0.420	2.566	0.047	1.206	0.389
,, 5 ,, ...	1.900	0.950	1.547	0.112	1.271	0.303
Mottled	1.650	1.560	1.130	0.163	1.255	0.288
White	0.350	2.950	0.605	0.231	1.203	0.274
Glazed	2.300	0.160	4.150	0.020	1.190	0.532

LINCOLNSHIRE.

Appleby Iron Co., Ltd.,

FRODINGHAM.

Brand—"Doncaster."

	G.C.	C.C.	Si.	S.	P.	Mn.
No. 1 ...	3.012	0.185	2.25–2.75	0.025	1.20	1.70
,, 3 ...	3.030	0.200	2.25–2.50	0.030	1.20	1.70

Redbourne Hill Iron and Coal Co., Ltd.,

FRODINGHAM.

Brand—"Redbourne."

	G.C.	C.C.	Si.	S.	P.	Mn.
No. 3 Foundry ...	3.100	0.560	2 751	0.038	1.326	1.480
,, 4 ,, ...	2.816	0.751	2.610	0.045	1.318	1.589
Grey Forge ...	2.525	0.895	2.508	0.056	1.316	1.446
No. 4 Close ...	2.459	0.945	2.452	0.059	1.296	1.344
Mottled	1.480	1.520	1.325	0 100	1.296	1.130
White	0.675	2.285	0.450	0.155	1.295	1.100

The Trent Iron Co., Ltd.,

TRENT IRON WORKS, SCUNTHORPE.

Brand—"Trent."

	G.C.	C.C.	Si.	S.	P.	Mn.
No. 3 Foundry ...	3.00	0.30	2.00	0.04	1.20	1.80

NORTHAMPTONSHIRE.

Thomas Butlin & Co., Ltd.,

IRTHLINGBOROUGH IRON WORKS, WELLINGBOROUGH.

Brand—"Butlin."

	G.C.	C.C.	Si.	S.	P.	Mn.
No. 1	3.790	tr.	2.800	0.006	1.682	0.360
,, 2	3.190	tr.	1.980	0.010	1.672	0.360
,, 3	3.223	0.181	1.780	0.018	1.609	0.398
,, 4	3.229	0.207	1.726	0.020	1.584	0.216
Mottled	1.166	1.179	2.660	0.168	1.648	0.216

NORTH STAFFORDSHIRE.

R. Heath & Sons, Ltd.,

BIDDULPH VALLEY COAL AND IRON WORKS,

NEAR STOKE-UPON-TRENT, STAFFS.

Brands—"Heath & Sons"; "R H.S."

	G.C.	C.C.	Si.	S.	P.	Mn.
No. 3	2.55	0.60	2.45	0.08	1.14	2.30
,, 4	2.60	0.54	1.90 to 2.00	0.07	1.09	2.20

SOUTH STAFFORDSHIRE.

Wm. Roberts (Tipton), Ltd.,

TIPTON.

Brand—"Roberts' Tipton Green Iron."

	Carbon	Si.	S.	P.	Mn.
No. 1	3.70	3.00	0 020	1.30	0.43
,, 2	3 50	2.50	0.025	1.30	0.43
,, 3	3.00	2.30	0 032	1.30	0.43
Forge	2.60	2,10	0 080	1.30	0.42

Philip Williams & Sons,

WEDNESBURY OAK WORKS, TIPTON.

Brand—

	G.C.	C.C.	Si.	S.	P.	Mn.
	2.50	0.50	0.93	0.08	0.45	0.56

WORCESTERSHIRE.

Cochrane & Co. (Woodside), Ltd.,

WOODSIDE IRON WORKS, NEAR DUDLEY.

Brands—"Woodside"; "C & Co"; "Adder."

	G.C. C.C.	Si.	S.	P.	Mn.
No. 4	3.046	1.218	0.08	0.419	0.228

M. & W. Grazebrcok,

DUDLEY.

Brand—"Grazebrook & Chilbrook."

	G.C.	C.C.	Si.	S.	P.	Mn.
No. 3	2.55	0.40	1.16	0.04	0.54	0.70
,, 4	2.40	0.50	1.00	0 07	0.50	0.64
,, 5	2.25	0.56	0 90	0.12	0.50	0.60
Cold Blast Cylinder Pig ...	2.60	0.50	1.00	0.08	0.47	0.50

YORKSHIRE.

Cargo Fleet Iron Co., Ltd.,

CARGO FLEET IRON WORKS, MIDDLESBROUGH.

Brand—"Cargo Fleet."

	G.C.	C.C.	Si.	S.	P.	Mn.
Basic pig	0.40	2.70	1.00	0.05	1.80	1.20

Gjers, Mills & Co., Ltd.,

AYRESOME IRON WORKS, MIDDLESBROUGH.

Brands—Foundry "Ayresome," Hematite, "H. Ayresome, H."

	G.C.	C.C.	Si.	S.	P.	Mn.
Mixed Nos.	3.767	0.275	2.371	0.033	0.041	1.325
No. 1 Foundry ...	3.570	0.120	3.000	0.030	0.65 to 0.75	1.500
High-silicon Hematite (6 per cent. Si.)	0.10	3.40	6.00	0.030	0.04 to 0.05	1.500

Sir B. Samuelson & Co,. Ltd ,

MIDDLESBROUGH.

Brand "B. S. Newport."

	G.C.	C.C.	Si.	S.	P.	Mn.
No. 3	3.50		2.75	0.04	1.40	0.50

Wilsons, Pease & Co., Ltd.

TEES IRON WORKS, MIDDLESBROUGH.

Brand—"G.W.L."

	G.C.	C.C.	Si.	S.	P.	Mn.
No. 3	2 70	0.20	2.90	0.05	1 50	0.60

The Farnley Iron Co., Ltd.,

LEEDS.

Brand—"Farnley."

	G.C.	C.C.	Si.	S.	P.	Mn.
Cold blast, No. 5	3.12	0.29	1.03	0.09	trace	0.46

Low Moor Co., Ltd.,

LOWMOOR IRON WORKS, BRADFORD, YORKS.

Brand—"Lowmoor."

	G.C.	C C.	Si.	S.	P.	Mn.
No. 1	2.940	0.590	1 324	0.042	0.362	1.096
,, 2	2.960	0.560	1.389	0.060	0.398	1.065
,, 3	3.080	0.550	1.385	0.049	0 367	0.808
,, 4	2.870	0.630	1 154	0.064	0.384	0.899
,, 5	2.570	0 810	0.736	0.089	0.383	0.839

Newton, Chambers & Co., Ltd.,

THORNCLIFFE IRON WORKS, NEAR SHEFFIELD.

Brand—"Thorncliffe."

	G.C.	C.C.	Si.	S.	P.	Mn.
No 1 Foundry	3.31	0 18	2.5-2 8	0.01	1.29	0.54
,, 2 ,,	3.25	0.20	2.63	0.01	1.33	0 58
,, 3 ,,	3.13	0.24	2.3-2.6	0 02	1.30	0.49
,, 4 ,,	3.09	0.31	2.0-2 3	0.02-0.03	1.31	0.52

SCOTLAND.

Carron Co.,

CARRON IRON WORKS, CARRON.

Brand—"Carron."

	G.C.	C.C.	Si.	S.	P.	Mn.
No. 1	3.500	.140	2.800	.035	1.000	1.000
,, 2	3.460	.200	2.275	.045	1.000	0.995
,, 3 Soft	3.350	.180	2.650	.038	0.999	1.000
,, 3 Foundry ...	3.350	.200	2.150	.060	1.000	0.908
,, 3 Close ...	3.170	.280	1.750	.065	1.005	0.850
,, 3 Hard ...	3.160	.300	1.570	.070	1.010	0.800

James Dunlop & Co., Ltd.

CLYDE IRON WORKS, TOLCROSS, GLASGOW.

Brand—"Clyde."

	No. 1 "Clyde" Pig Iron.	No. 1 "Monkland" Pig Iron.	No. 1 "Clyde" Hæmatite Pig Iron.
	Per Cent.	Per Cent.	Per Cent.
Silicon	3·260	3·450	3·600
Sulphur	0·022	0·028	0·028
Phosphorus	0·480	0·640	0·045
Manganese	0·790	0·650	0·790
Combined carbon	0·180	0·270	0·140
Graphite	3·260	3·480	3·350
Iron (by difference)	92·608	91·482	92·987

The Glengarnock Iron & Steel Co., Ltd.

127, ST. VINCENT STREET, GLASGOW.

Brand—"Glengarnock."

	G.C.	C.C.	Si.	S.	P.	Mn.
No. 1	3.50	0.20	3.50	0.04	0 60	1.10
,, 2	3.25	0 25	3.00	0.04	0.60	1.10
,, 3	3.25	0.30	2.75	0.05	0.60	1.10
,, 3 Hard ...	3.10	0.35	2.00	0.06	0.60	1.10

The Langloan Iron & Chemical Co., Ltd.,

COATBRIDGE.

Brand—"Langloan."

	G.C.	C.C	Si.	S.	P.	Mn.
No. 1	3.00	0.15	3.00	0.025	0.049	1.45
,, 3	2.85	0.25	2.82	0.035	0.050	1.51

Merry & Cuninghame, Ltd.,

127, ST. VINCENT STREET, GLASGOW.

Brand—"Carnbroe."

	G.C.	C.C.	Si.	S.	P.	Mn.
No. 1	3.60	0.15	3.50	0.03	0.90	1.20
,, 3	3.30	0.30	2.60	0.04	0.90	1.10
,, 4	3.20	0.40	2. 0	0.06	0.90	0.92

Summerlee Iron Co., Ltd.,
SUMMERLEE, NEAR COATBRIDGE, N.B.

Brand—"Summerlee."

	G.C.	C.C.	Si.	S.	P.	Mn.
No. 1.	3.25	0.25	2.85	trace	0.80	0.90

WALES AND MONMOUTHSHIRE.

The Briton Ferry Works, Ltd.,
BRITON FERRY, GLAMORGANSHIRE.

	G.C.	C.C.	Si.	S.	P.	Mn.
Bessemer No. 1 ...	3.80	0.38	2.80	0.02	0.045	1.40
,, ,, 2 ...	3.00	0.50	2.00	0.04	0.045	1.00
,, ,, 3 ...	2.80	0.80	1.50	0.05	0.045	0.80
Foundry	2.00	1.00	1.20	0.07	0.050	0.50

The Brymbo Steel Co., Ltd.,
BRYMBO, NEAR WREXHAM, DENBIGHSHIRE.

	G.C.	C.C.	Si.	S.	P.	Mn.
Basic	—	—	0.60	0.07	2.00	2.00
,, ...	—	—	0.70	0.06	2.00	2.50

The Ebbw Vale Steel, Iron & Coal Co., Ltd.,
EBBW VALE, R.S.O., MON.

Brand—"E. V. S 2."

	G.C.	C.C.	Si.	S.	P.	Mn.
Foundry "E.V. S 2."	3.30	0.20	2.50	0.06	0.50	0.50
Hematite No. 1 ...	3.50	0.17	2.50	0.03	0.06	0.50
,, ,, 2 ...	3.37	0.24	2.00	0.05	0.06	0.50
,, ,, 3 ...	3.05	0.35	1.80	0.06	0.06	0.50

Messrs. Guest, Keen & Nettlefolds, Limited,
DOWLAIS.

Hematite Pig-Iron.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Combined carbon .	0·30	0·32	0·42	0·47	0·54
Graphite . .	3·75	3·50	3·20	2·94	2·92
Silicon . .	2·20	1·96	1·85	1·60	1·40
Sulphur . .	0·025	0·035	0·055	0·08	0·135
Phosphorus .	0·05	0·05	0·054	0·053	0·062
Manganese .	1·15	1·04	0·70	0·68	0·64
Iron (by difference) .	92·525	93·105	93·721	94·377	94·613

Mottled and White Hematite Pig-Iron.

	Mottled.	White.
	Per Cent.	Per Cent.
Combined carbon . . .	1·90	2·66
Graphite	1·00	0·20
Silicon	0·60	0·50
Sulphur	0·20	0·26
Phosphorus	0·054	0·052
Manganese	0·36	0·33
Iron (by difference) . .	95·886	95·778

TYPICAL ANALYSES.

Cumberland.

Cumberland Hematite Pig-Iron.

	G.C.	C.C.	Si.	S.	P.	Mn.
No. 3	3.51	0.17	2.49	0.04	0.035	—
	3.25	0.54	2.10	0.04	0.045	Trace.

Derbyshire.

G.C.	C.C.	Si.	S.	P.	Mn.
3.65	0.31	2.60	0.020	1.40	1.02
2.97	0.35	2.47	0.035	1.40	

Cleveland, Durham, and Yorkshire.

East Coast Hematite Pig-Iron.

	No. 1.	No. 2.	No. 3.	Forge.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Combined carbon .	0·15	0·30	0·45	0·80
Graphite . . .	3·50	3·30	3·05	2·60
Silicon . . .	2·75	2·50	2·30	2·00
Sulphur . . .	0·03	0·05	0·07	0·10
Phosphorus . .	0·05	0·05	0·05	0·05
Manganese . .	1·30	1·25	1·00	0·80
Copper . . .	0·03	0·03	0·03	0·03
Iron . . .	92·19	92·52	93·05	93·62

Lancashire.

	G.C.	C.C.	Si.	S.	P.
No. 3	3.25	0.18	3.03	0.051	0.67

Lincolnshire.

The following analyses representing typical brands of Lincolnshire pig-iron are officially supplied by the Lincolnshire Ironmasters' Association.

	No. 1.	No. 2.	No. 3.	No. 4 Foundry.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Graphite	3·17	2·94	2·72	2·30
Combined carbon . .	0·16	0·37	0·53	0·70
Silicon	2·69	2·46	2·30	1·82
Sulphur	0·031	0·035	0·043	0·044
Phosphorus . . .	1·12	1·20	1·23	1·31
Manganese . . .	1·06	1·78	1·47	1·41
Iron (by difference) . .	90·97	91·21	91·71	92·42

	No. 5 Forge.	No. 5.	No. 5 Hard	Mottled Pig Iron.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Graphite	2·89	0·55	0·82	0·93
Combined carbon . . .	1·15	2·91	2·37	2·5
Silicon	1·53	0·94	1·20	1·36
Sulphur	0·058	0·078	0·074	0·072
Phosphorus . . .	1·28	1·39	1·31	1·34
Manganese . . .	1·39	1·23	1·26	1·28
Iron (by difference) . .	91·70	93·01	92·97	92·53

	Spotted White.	White	Spiegel White.	Basic.
	Per Cent.	Per Cent.	Per Cent	Per Cent.
Graphite	0·31	0·18	0·15	0·15
Combined carbon . . .	3·19	3·28	3·3	3·35
Silicon	0·76	0·64	0·61	0·53
Sulphur	0·081	0·086	0·05	0·05
Phosphorus . . .	1·43	1·37	1·35	2·13
Manganese . . .	1·27	1·24	1·17	2·10
Iron (by difference) . .	92·97	93·22	93·37	91·70

Northamptonshire.

G.C.	C.C.	Si.	S.	P.	Mn.
3.10	0.35	3.20	0.040	1.65	0.48
3.04	0.08	2.75	0.020	1.69	

North Staffordshire.

	G.C.	C.C.	Si.	S.	P.	Mn.
	2.53	0.42	2.89	0.029	1.29	1.92
No. 3	2.90	0.47	2.50	0.035	1.25	

South Staffordshire.

	G.C.	C.C.	Si.	S.	P.	Mn.
All mine	2.86	0.37	2.35	0.060	0 62	0.73
Cold Blast ...	2.50	0.55	1.05	0 101	0.48	—
,, ,, No. 5	2.15	0.61	0.95	0.110	0.51	0.72

Scotland.

	G.C.	C C.	Si.	S.	P.
Ayrshire No 3	3.01	0.47	2 33	0.027	0.560
,, ,, ...	2.57	0.43	2.63	0.033	1 150
Lanarkshire No. 3 ...	3.10	0.19	3.15	0.014	0.810
Stirlingshire close No. 3	2.72	0.68	1.56	0.101	0.610

Runner Basins.

By the use of runner basins a good deal can be done to ensure clean castings. With the basin shown in Fig. 1, a runner core is set over the down gate as shown. To prevent a run-out at the joint between the core and the top of the mould it is best to stamp the core on to a layer of loam, having first closed the down gate with a little cotton or jute waste; where flour is used a ring of dough

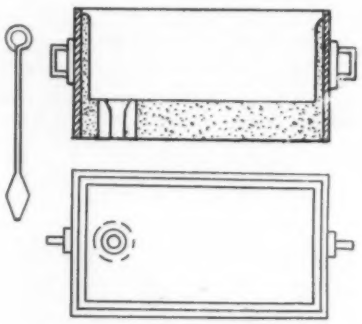


FIG. 1.

would be more quickly applied. A ball of clay is then squeezed into the mouth of the core, a large plug placed on top and the runner box rammed up with rough sand. The basin is then cut out as desired, and finished with a little fine sand, the clay taken out and the cast-iron plug with lifting handle inserted. This plug should be dipped in blacking, dried, and used warm. There is a considerable waste of metal about this basin, but where it is the practice to bring the metal for a dozen or so moulds in a ladle holding two or three tons and

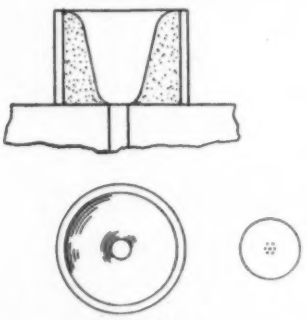


FIG. 2.

to pour direct from it, a large basin is necessary owing to width of the stream of metal. The plug can also be used on large work where it is desired to let in, say, half the metal through gates in the bottom of the mould, afterwards withdrawing the plugs and filling the remainder of the mould with gates placed on top of the casting.

Where the metal is brought in small quantities on a railway or trolley track, the basin shown in Fig. 2 is very useful for small, dry sand moulds. A sheet of tin with a few small holes punched in it is placed over the down-gate, a little dough or loam laid around, and the basin, or bush, as it is called in some districts, placed in position. It is best to ram these small bushes up overnight and dry them. When pouring, the sheet of tin serves to check the metal a little until the basin is full, and the holes permit the ready burning away of the tin so as to allow the metal free ingress. Such a sheet of tin must not be hidden away in some part of the mould

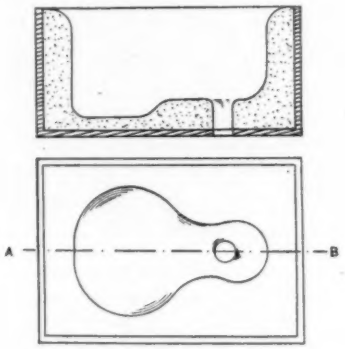


FIG. 3.

where the metal has lost its force; it should be placed where the metal drops from the ladle, or else there will be trouble.

In some foundries it is considered necessary to make a well in the runner basin to take the drop of the metal as shown in Fig. 3; as a result a large amount of scrap is made where large castings are turned out, except in such cases as the making of chilled rolls, etc., where the runner is placed high enough and a run-off provided from the head to take all the metal from the runner. As a contrast to Fig. 3, may be cited the type sketched in Fig. 4, which is used very successfully in the making of large castings. This basin is shown as rammed up with green sand, a number of loam bricks being placed in the slope where the metal drops from the ladle. It is better to brick up a box carrying the sloping portion and a little more. This can be dried,

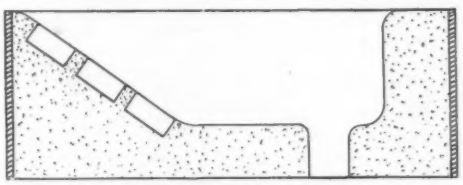


FIG. 4.

and with a little patching will serve for many casts, as it can be easily placed in position by the crane, and the remainder of the runner made up to suit the job.

MR. L. J. FIRTH, a managing director of Thos. Firth & Sons, Limited, Norfolk Works, Sheffield, is retiring from the board of the company next spring. Mr. Firth will retain his connection with the Firth-Sterling Steel Company, U.S.A., of which company he is president. Mr. F. C. Fairholme, at one time managing director of Cammell, Laird & Company, Limited, has been elected a director of the company.

Wasters in the Foundry.

By F. A.

Most foundry foremen are expected to prevent the production of bad castings or wasters, but the writer could quote several cases where a little more judgment on the foreman's part might have saved a deal of time, trouble, and addition to expense. There are some foremen who, though possessing very little scientific knowledge, seem to be able to keep the quantity of "wasters" produced to a remarkably low amount. An explanation of this, however, would often be obtained by an early visit to the foundry and the charging platform before a chance of destroying or hiding bad castings occurred. In a jobbing shop, where, of course, there is a greater possibility of making a fresh casting without discovery, it might seem that wasters were very rarely made, and then only on really urgent jobs. Should proper supervision be given at any time the percentage of wasters increases from none to the normal amount.

In many cases the foreman is compelled to rely on the judgment of the particular man who is given a job to execute. Fig. 1 shows a half sectional elevation and plan of a pattern for a valve cup, all in one piece, and resembling a circular tank. Two castings were required from this pattern, to be 6 in. deeper when cast than the original depth. To make these castings would have been a much simpler job had the plate at the top been loose instead of the sides and top all in one piece. However, the pattern was there and the castings had to be made from it. The moulder proceeded to make the mould, as shown in Fig. 2, ignoring a suggestion that it was too tender a job. Fig. 3 shows the method suggested by the assistant moulder, which would have saved much time and been more sure.

In the method illustrated in Fig. 2 the increase of 6 in. was obtained by lifting off the middle at K, involving a vertical lift of 6 in. before any clearance was obtained after the pattern was withdrawn. It will be readily understood that the corner K was left in a ragged state, for the thickness of the casting was only $\frac{1}{4}$ in. at the bottom; more than ordinary skill would be required to finish to anything like the correct shape. In addition, the central core must be scraped, and the chances are that the castings come out all thicknesses. As a matter of fact, two were made and scrapped, and then the pattern had to be lengthened 6 in. In the method illustrated in Fig. 3, the pattern would be drawn up 6 in., and the increase in the length of the core made up by a green sand core, as shown in Fig. 4, and secured by hooks, as shown. The top being flat would be rammed up separately; after withdrawing the pattern the middle would be lifted off without any danger of destroying the corner L, and be replaced when the core had been secured, and the joint produced made good.

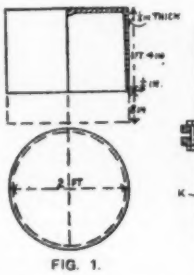


FIG. 1.

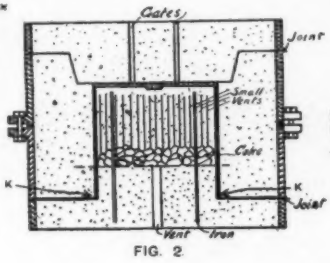


FIG. 2.

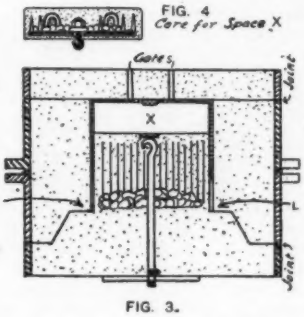


FIG. 3.

Much might be done by firms making a speciality of jobbing pipes, to reduce the number of wasters produced. From experience it is found that certain boxes are a handy size for different jobs, and, of course, get used pretty frequently. Not being of the everlasting variety, they eventually require replacing. One box does not take much time in moulding, but when the number of risky boxes becomes great, the task of replacing seems too large a job, and gets neglected. Meanwhile the moulder keeps using the old boxes carefully, so that no drop-out shall occur, but eventually, and perhaps when the last metal is down and waiting to be poured in the mould, the box gives way and a drop occurs.

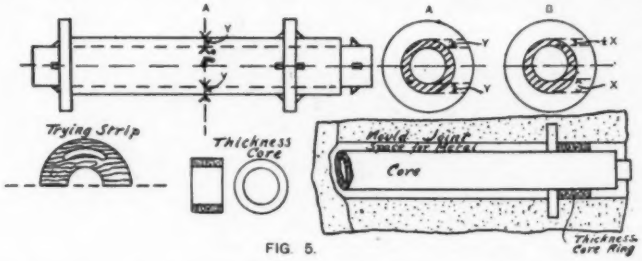


FIG. 5.

Difficulty is sometimes experienced owing to the core being out of centre, thin in the top half and thick in the bottom half of the casting, as shown at

Fig. 5, instead of being as at A. If the simple 4 in. straight length shown in Fig. 5 is followed it will be seen that a perfect print is left at one end only for the flange stops, which are easily stopped off. The other end requires a print making up for the support of the core. This is an easy job if one has a good half-flange which fits the print, and is of the same diameter as at the other end. If, however, the flange is thicker it cannot be used for a guide, and one is left to guess at the print; then with luck attending, the core manages to get in the right place and does not push the top of the back flange in. To avoid this crushing some moulders take off plenty of clearance in the top print and run the risk of getting the

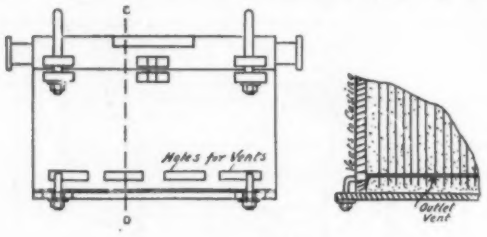


FIG. 6

core out of centre. To avoid, by other means than excessive clearance, this crushing of the top, a trying strip similar to a half-flange should be provided for each standard size, as shown in sketch, so that the core may be tried for height where the top print comes, and lowered if necessary. Another way would be to have standard thickness core rings, as shown, and also in position on the pipe core in mould, thus making sure of the thickness of top, bottom and sides. These rings should be of metal if necessary, so as to be capable of being used repeatedly. In casting pipes the foreman should see that the runner box holds sufficient metal and is of good depth instead of allowing the shallow saucer-like arrangement made by some moulders. Of course, the foreman cannot pretend to inspect every little detail, but he can at least insist on properly made-up runner boxes. A square or rectangular runner box of good depth allows the pourer to fill it at once without risk of the formation of a whirlpool, which sucks dirt and slag down.

In work such as roof gutters for building work, a deal of trouble is often taken in laying a coke bed underneath the casting, when cast hollow-side down. This coke bed is sometimes, however, owing to carelessness, not renewed as it gets choked, and on the moulder ramming the inside harder than usual, a series of unsightly scabs on the casting results. Fig. 6 shows a method whereby a coke bed may be dispensed with in the majority of cases where a cope and drag box are used. A series of slots are cast in as shown, and through these the vent wire is easily forced, these vents catching the vents running downward from the casting. Without these slots the venting is done under the grid, and if the box has been set any time the sand underneath becomes hard and provides a good excuse for the moulder slipping his venting. By means of these slots less time is taken than in the preparation of a cinder bed, and the sand in the box being constantly disturbed, venting by the slots is an easy matter. Where the pattern is bedded into the floor, of course, a cinder bed is the best way. The material for a bed of this description should consist of large pieces of coke or clinker laid on a hard flat bed or plate in the bottom of the pit. Over these large pieces should be laid some smaller pieces, and finally some smaller still, covered with hay, straw or sacking, the total depth being not less than 12 in. A number of pipes, one end in the bed and the other just above the floor level, must be provided for the outlet of the gases, and be covered when not in use to prevent them from being filled with sand. Care must be taken that for heavy work the bed is rammed firm, so that it will not give way to the pressure of the metal above it, and that the pattern is not too close to the bed.

The Formation of Silicon Sulphide in the Desulphurisation of Iron.*

By W. Fielding.

In the refining of steel in the electric furnace a very complete desulphurisation of the metal can be effected, and this action is facilitated by the addition of a charge of ferro-silicon. Several explanations have been put forward to account for this influence on the removal of sulphur.

The object of the author was to investigate the conditions under which ferro-silicon can react with ferrous sulphide and liberate a sulphide of silicon, and the reaction of the two compounds was investigated by heating intimate mixtures of them in a vacuum at known temperatures. The heating was effected in a crucible in the form of a hollow graphite rod, heated electrically.

When the commercial variety of iron sulphide was used the mass fused at a temperature of about 930 degrees C., and a vigorous reaction set in with rise of temperature. Using pure iron sulphide (free from oxide) no reaction was observed up to about 1,300 degrees C., hence the reaction noted in the first case was probably due to reduction of oxide of iron present by the ferro-silicon. This explains the sudden rise of temperature noted.

In all the experiments a yellow sublimate began to appear on the walls of the tube at a temperature of 1,500 degrees C. A larger quantity of this product was subsequently prepared, and found to consist of approximately 50 per cent. silicon sulphide (assuming the formula to be SiS_2), the remainder being iron sulphide which had volatilised, silica (obtained from the action of moisture in the air on the silicon sulphide), and a small amount of ferric oxide in a finely divided state. In different experiments products of variable composition were obtained, and it has not been possible to fix the identity of the sulphide of silicon present in the product.

Professor A. K. Huntington thought it more probable that what was sublimed was a silico-sulphide of iron. He believed that oxy-sulphides of metals were formed more often than is generally supposed.

Mr. F. E. Pollard controverted the author's assumption that the sulphur exists in combination with the iron. He considered that sulphur exists almost entirely in combination with the manganese.

Dr. T. M. Wilsmore said that silicon sulphide was not the indefinite substance the author imagined; three compounds—SiS_2 (white), SiS (yellow), and SiOS—had been isolated.

* Abstract of Paper read before the Faraday Society.

Wood-Turning Lathes.

The illustration shows a standard pattern wood-turning lathe suitable for pattern-makers' work. The lathe is made with or without the overhung face-plate as shown, and also can be supplied with gap bed, or without the traversing saddle, these features being governed by the work for which it is utilised. The principal feature of the machine is the design of the running head. Great care is taken with the balancing of the spindles, and each head is subjected to a test of running at three times its usual working speed; the head being kept at this speed until the spindle will run perfectly smooth without heating. Any type of hand-rest can be fitted as required, and the lathes are sometimes made with an automatic feed to the saddle, while, in other cases, as shown on illustration, the saddle has a geared feed.

When the lathe is to be used for turning large diameters, an overhung face-plate, as shown, is used. The pillar rest for working in this case is fixed on a cast-iron sole-plate, thus making it perfectly rigid. The lathe is made in several sizes, ranging from 6 in., height of centres, and 8 ft., length of bed, to 15 in., height of centres, and 14 ft., length of bed. The makers are Messrs. Thos. White & Sons, Limited, of Paisley, who also produce a heavier type of wood-turning lathe, 15 in. to 24 in., height of centres, 14 ft. to 16 ft. length of bed. These also are made either with or without traversing saddle, gap bed, or overhung face-plate, and are of massive construction throughout. This heavier type is illustrated in Fig. 2.

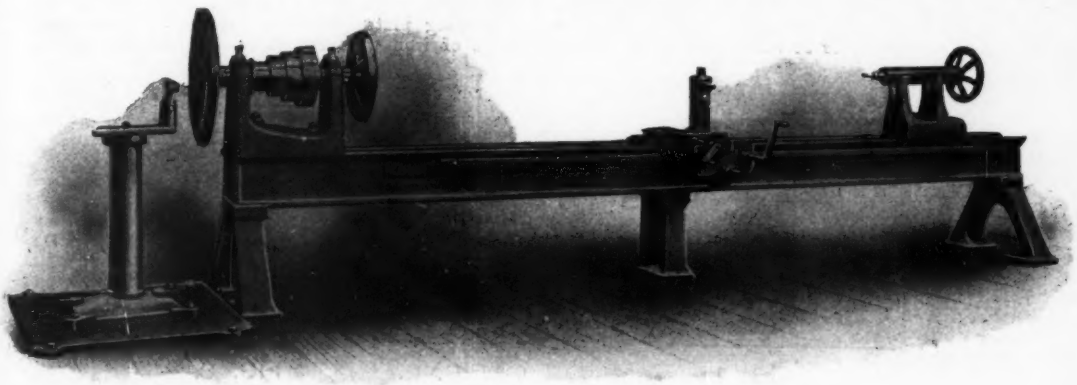


Fig. 1.—Pattern-Maker's Wood-Turning Lathe.

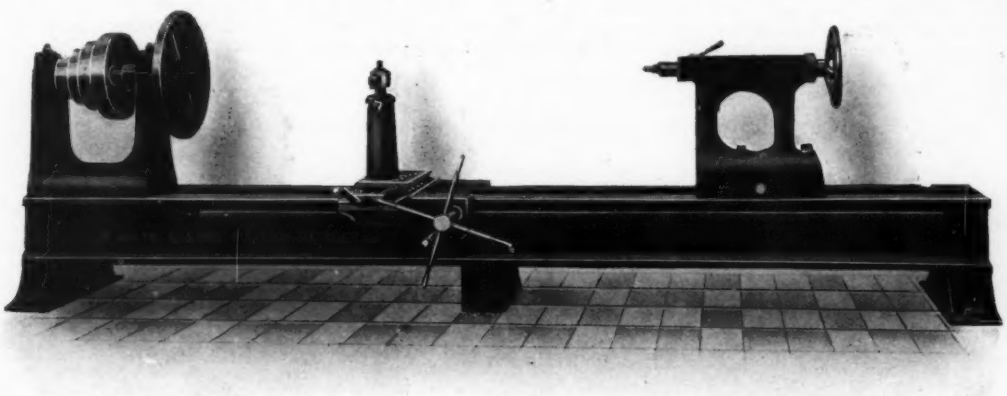


Fig. 2.—Heavier Type of Wood-Turning Lathe.

By an outbreak of fire in the pattern shop of Mr. William Shepherd, ironfounder, Lindsay Street, Arbroath, on July 3, damage was done to the extent of several hundred pounds.

Rapping and Lifting Plates.

By A. Napier.

Rapping, which is the process of loosening the pattern from the sand while still in the mould, is essentially performed by inserting a bar in the pattern and rapping this bar sideways in all directions until the sand is compressed slightly and the pattern thus freed, allowing it to be withdrawn easily. With small patterns a spike can be simply driven into the wood and struck lightly a few times; this is sufficient to release the pattern, which can be lifted out at once. With a large and heavy pattern, however, the effect of driving in a spike and hammering at it to sufficiently loosen the pattern would soon prove disastrous; accordingly, for large work rapping plates, generally of malleable iron, are employed. The rapping operation is often performed by merely boring a hole in the pattern and inserting a bar which is struck to loosen the pattern, as already stated, screws being then twisted in to lift by; but the better way is to employ rapping plates which combine a hole for the lifting screw and the hole for inserting the bar to be struck with the hammer.

With work of considerable size and weight the use of a plate let into the pattern to receive the bar, which may be anything up to 1 in. in diameter, is obvious. The clearance required depends on the class of work: the larger and deeper the pattern the greater is the amount of rapping required, and the operation will need to be repeated over several different portions of the pattern.

Rapping plates differ in detail, but are usually strips of iron with two holes—one for the rapping bar and one for a screw for lifting the pattern by The plate commonly used in this country is shown in Fig. 1. These plates are let into the wood by means of a chisel and mallet or other suitable tools. Numerous sizes and widths may be obtained, the larger sizes being provided with bosses for both the rapping and lifting holes. These bosses, being sunk into holes bored in the wood, help to steady the plates under rough usage in rapping. The narrower plates of the design shown are used on the edges of the rims of wheels, pulleys, flanges, ribs and such work, while the broader plates are used on the wider surfaces of patterns.

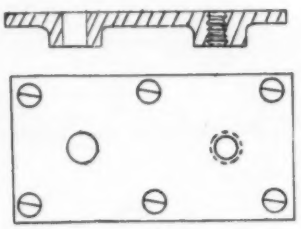


FIG. 1.

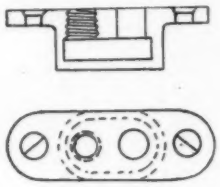


FIG. 2.

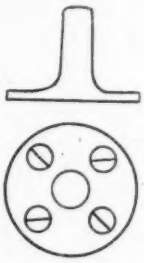


FIG. 3.

EXAMPLES OF RAPPING AND LIFTING PLATES.

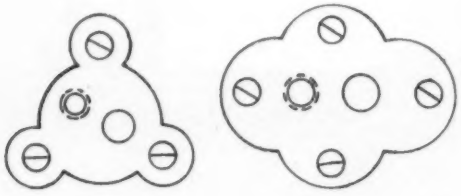


FIG. 4.

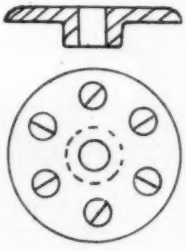


FIG. 5.

EXAMPLES OF RAPPING AND LIFTING PLATES.

While this class of plate serves satisfactorily for most classes of work, special jobs need to be treated in a special way. In Fig. 2 is shown a plate that has been recommended, and has met with considerable success. It will be seen that in addition to the features of the plate, Fig. 1, the chamber under the

holes prevents the sand from being jammed in either of them, as it can pass under to the other hole. This prevents the plates being forced off by that means.

For smaller work a plate with a short pin cast on it is recommended and for this class of work serves the purpose quite as well. This plate is shown in Fig. 3, and consists of a circular plate and the pin mentioned, this latter serving both as the rapping bar and for lifting the pattern. The plate can be let into the pattern by boring a hole with a centre-bit, and this saves the square chiselling required by the square forms of plate. Other plates that can be fitted in the same way are shown in Fig. 4, these being used to some extent in America. A circular rapping plate is used often for the backs of gear-wheel bosses; this is shown in Fig. 5, the small boss serving to keep the plate steady during rapping.

The lifting screw used with the rapping and lifting plates may take any form suitable for obtaining a hold on to; one end, of course, being screwed to fit the tapped hole in the plate. The common form of lifting screw has a looped end for the lifting tackle (when such is used), the screw end being slightly tapered, and with or without a flange above the screw.

Some judgment is needed in the selection of plates for the different patterns or parts of patterns, and it is well to remember not to use a small plate where a larger one can be conveniently fitted, for the larger and stronger the plate the better will it perform its duties. The plates should be screwed on as securely as possible and with screws as long as possible, to prevent them being wrenched out. Such an accident would probably occur when the mould was completed, and the pattern being lifted, with the result that the mould would be destroyed. Particular care is necessary with plates for standard patterns, for as these are being frequently used they are likely to suffer damage and strain. When a standard pattern is of moderate thickness only, it is best not to put in at first the stoutest screws which the plate will hold, but to use screws of rather smaller size at first; as these become slack they can be taken out and screws a few sizes larger substituted.

The trouble of the plates being wrenched off has often to be contended with when the patterns are thin, but in many cases it can be guarded against by (1) putting the plates on the face without letting them in, except for the bosses, if any; (2) putting an extra strip of wood under the pattern and screwing through to get a hold into that also; or (3) putting plates on both sides of that part of the pattern and bolting or rivetting through. In each of these cases it would be necessary to fill up the impressions left in the mould by the extra thicknesses of material. With very heavy patterns ripping off of plates may be prevented by the use of two plates—one for the rapping and one for the lifting screw. The rapping plate is placed on the top of the pattern in the usual way, but the lifting plate is placed on the underside of the timber directly beneath the rapping plate. The lifting screw can then be put through the rapping hole after that operation has been completed, and through a hole bored in the pattern into the lifting plate beneath. By this means the lift is a direct one with the weight on top of the lifting plate instead of underneath, where it would tend to draw the plate off the pattern.

There are numerous other expedients that can be adopted for different jobs, all of which make the handling of the patterns safer. One important point to remember is that lifting plates should be distributed so that the pattern is well balanced, and no one plate takes undue strain. The proper use of rapping and lifting plates will often save a pattern considerable rough usage in the hands of the moulder, and particularly with standard patterns this is important. The cost of the plates, too, is only trifling, and is not sufficient to warrant the adoption of clumsy expedients.

Centenary of the Friendly Society of Ironfounders.

The centenary of the Friendly Society of Ironfounders of England, Ireland, and Wales, was celebrated at Belle Vue, Manchester, on Saturday, June 26. Thousands of members of the Society from various parts of the country were present to rejoice over an event unique in the annals of Trade Unionism, this being the first Trade Union to live to such an age. On February 6, 1809, the Friendly Ironmoulders' Society, as it was then called, had its birth at the Hand and Banner public house at Bolton-le-Moors, in the county of Lancashire. The new organisation started, not as a Trade Union, but as a sick, funeral, and mutual benefit society. It is interesting to note that while in the old days moulders were regarded by other workers as an inferior class—as anything but the aristocracy of labour, like silver-smiths and engineers—a moulder now leads the forces of Labour in the British House of Commons.

The demonstration at Belle Vue, and the procession from the headquarters of the Society which preceded it, were a great success. A fourth of the members, some 5,000, with banners flying and bands playing, marched in procession to the Zoological Gardens at Belle Vue. Openshaw military band headed the procession, and behind them followed the banner of the Bolton branches bearing unmistakable signs of antiquity in its painted emblem of the Society. Then came three M.P.'s, Mr. Arthur Henderson (Leader of the Labour Party), Mr. D. J. Shackleton, and Mr. G. N. Barnes, together with the Chairman of the Executive and the General Secretary. The veterans of the trade—the superannuated members—were accommodated in wagonettes in the procession.

Among the interesting mottoes displayed were:—"1809, 119 Members; 1909, 19,000 Members." "£2,208,026 Distributed in Benefits—we have Brightened Many Homes." While another announcement was, "The Iron Founders supplied the L.R.C.'s first Labour Member of Parliament."

After tea, speeches were delivered in the auditorium by the four M.P.'s, the moulders' own member, the leader of the Labour Party, occupying the position of honour in the centre.

Mr. James Bell, Chairman of the Executive Council, occupied the chair at the evening meeting. He was supported by Mr. Arthur Henderson, M.P. (Ironfounders' Society), Mr. D. J. Shackleton, M.P. (Textile Workers), Mr. Will Crooks, M.P. (Coopers), Mr. G. N. Barnes, M.P. (ex-General Secretary, Amalgamated Engineers), Mr. W. M. Lawson (General

Secretary, Ironfounders' Society), Mr. J. Olive (Assistant General Secretary), the Executive Council, and others.

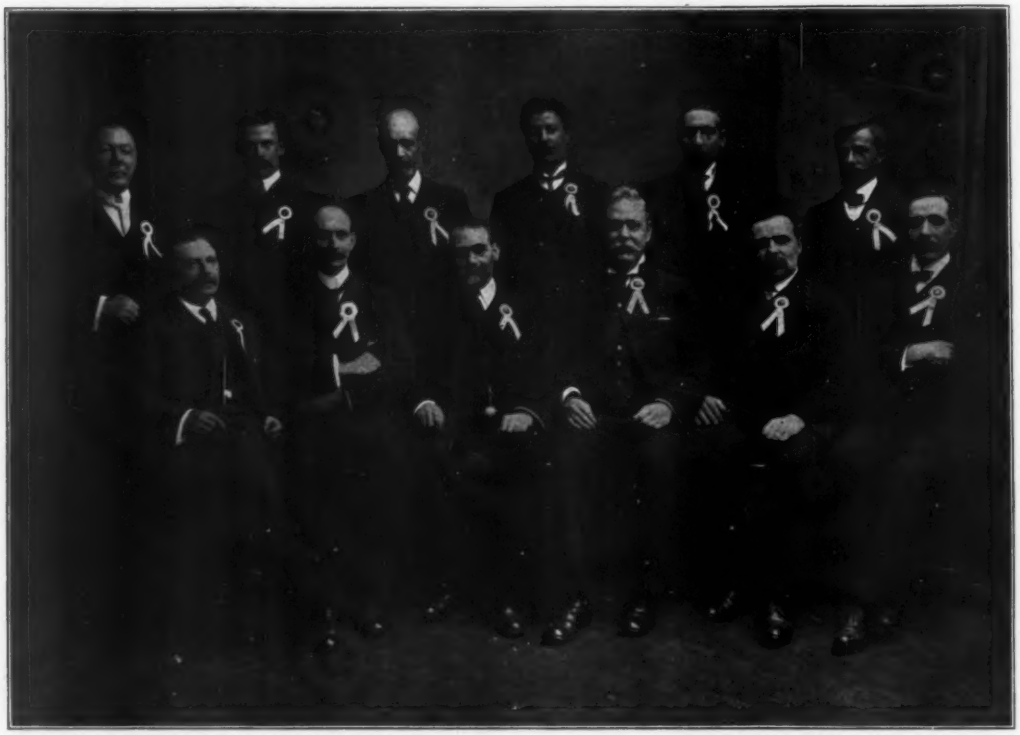
Letters of greeting and congratulation came from the General Federation of Trade Unions, the International Moulders of America, and the Associated Iron Moulders of Scotland.

Mr. D. J. Shackleton, M.P., who followed the Chairman in addressing the meeting, said the centenary celebration was, to his mind, almost unique. Their very name—"Friendly Society" of Ironfounders— indicated what had been in times now passed. "Friendly society" was a term used because it was illegal for the founders of the organisation to call themselves a "Trade Union"; so they did the illegal thing under that guise.

bers of the Ironfounders' Society were now fully qualified metallurgists, and so when merit predominated their star shone more brightly.

Mr. John Davison, of Sheffield, who seconded the resolution, remarked that the Society had proved a more effective instrument in promoting, maintaining, and improving the working conditions of the men engaged in the founding trade than probably any other organisation could.

After Mr. G. N. Barnes, M.P., had addressed the meeting, Mr. Arthur Henderson, M.P., rose to support the resolution. He said that surely the thought uppermost in the mind of every member of the Ironfounders' Society assembled there that day must be one of very deep gratitude to those who, in the dark days of the past, laid the foundation of an organisa-



IRON FOUNDERS' CENTENARY COMMITTEE, 1909.

P. Whiteside. H. Ellis. R. Midgley. J. E. Davison. W. E. Wilkinson. F. Williams.
J. Jukes. W. M. Lawson. J. Bell, *Chairman*. J. Olive. J. N. Walker. T. Day.

Mr. F. Lockyear, of London, and a member of the old Metropolitan Executive, moved a resolution, expressing great satisfaction that the Friendly Society of Ironfounders, England, Ireland, and Wales, had reached its centenary, and rejoicing in the fact that during this long period the Society has proved an effective instrument in promoting, maintaining, and improving the working conditions of those engaged in the foundry trade.

Turning to the technical side of their interests, Mr. Lockyear said the foundry was no longer looked upon with disgust. Chemists were recognising that the working of metals was often above their knowledge, and so prospective managers were going through a course of foundry instruction. In fact, many mem-

tion which had lived to make it possible to celebrate its centenary. (Loud applause.) After commenting on the advance that had been made in the conditions of the foundry workers, "I make safe to say, therefore," he added, "not only should we be prepared to give our unanimous and enthusiastic endorsement to this resolution out of gratitude to the founders of the organisation, out of a debt of reverence to their memory, but because we are convinced that this union has proved—and, I will venture to say, is destined to still further prove—to be a most effective instrument in improving the conditions of those engaged in the founding trade." (Applause.)

After further speeches the resolution was carried heartily, and the meeting broke up.

Pyrometry in the Annealing Room.*

By S. H. Stupakoff.

The satisfactory production of malleable iron castings depends to a large extent upon subjecting the hard castings to a suitable heat treatment which effects a transition of the originally white iron into the well-known soft grey-black variety. The change from hard white into soft grey-black, or "black heart" iron, as it is often called, is effected by a prolonged reheating of the castings, known as annealing. The annealing or softening of the material is really the principal object sought. However, this softening is only coincident with other chemical changes that take place during this process, which are in truth the primary results of reheating the hard white iron for a specified length of time within definite limits of temperatures. Other physical changes that occur at the same occasion, such as increase in ductility, elongation, bending movement, tensile strength, and malleability, are of even greater value and importance to the subsequent application in the arts of this excellent variety of iron.

It is not the intention to dwell here upon the composition of malleable iron mixtures, as they have been discussed at length by ackonwledged authorities on the subject. Suffice it to state that the mixture consists essentially of a low carbon iron with about 0.70 per cent. to 1.00 per cent. silicon. This iron on melting under suitable conditions will after casting turn out with a silvery white fracture, and extremely hard and brittle. In this condition it is almost absolutely useless for any purpose. Nearly the whole of its carbon contents is present in the combined state, *i.e.*, chemically combined with the iron. The object of the annealing process is to break up this combination and to transform the combined carbon into a non-crystalline graphitic state. As such it will then be present in the iron merely as a mechanical mixture and provided all other conditions are equally favourable, the result will be a malleable cast-iron with its well-known good qualities.

The manufacturer of malleable cast-iron has long since submitted to the necessity of relying upon the services of a trustworthy metallurgist, who selects his mixture from among various grades of iron, calculates the necessary quantities of each, basing his work on a careful chemical analysis of the raw materials as well as of the product. But the best brands of iron, the most suitably compounded mixture and the most carefully executed analysis alone will not result in a good product. There is the melting process in all its details to be duly taken into consideration, and this is usually left to the judgment of the melter. Last, not least, we have in the annealing process one of the most important stages in the production of malleable iron which governs the physical qualities and the commercial value of the product. These important stages of heat treatment of malleable iron are left in many establishments to the fallacious personal judgment of a few operators, whose principal qualification is that they have grown up in the business.

The point aimed at in this paper to impress upon all interested parties that, since trustworthy instrumens are available for following up the various stages of the heat-treatment of materials, we should use them freely and intelligently and thereby become independent of the personal factor.

* Abstract of a paper presented before the American Foundrymen's Convention.

Heat Measuring Instruments.

Mercury thermometers are now obtainable reading up to nearly 1,000 degrees F.. *Mechanical thermometers* form a class of heat measuring instruments distinct by themselves. They are mostly constructed upon the basis principle of the unequal expansion of two different metals when exposed to varying degrees of temperature. The expansive force is transmitted to a pointer which moves over a graduated scale. These instruments are constructed entirely of metal, excepting that the pointer and dial are covered by a disc of glass. They are suitable for indicating temperatures up to about 600 degrees F.

Parenthetically *Thermometers* include all instruments for any range of temperature from the lowest (the absolute zero) up to the boiling point of mercury (676 degrees F.), while others that are adapted for ranges higher than this point are usually designated as *Pyrometers*.

Expansion Pyrometers are constructed upon the same general principle as mechanical thermometers, but are intended for higher ranges of temperatures. They enjoyed for many years quite an extensive distribution and use in many branches of the industries, but within the last two decades they were compelled to make room for the more modern types of instruments. When used for short periods of exposure up to within moderately high limits they give reasonably close indications. The claims usually made for them should be accepted with caution, and it is always advisable when using them in practice, to remain considerably below their given maximum to avoid permanent setting of their vital parts.

Electric Resistance Pyrometers are of modern construction. They are exceptionally sensitive to small variations of temperatures, and they give very close and trustworthy readings when judiciously used within their limits. They must not be exposed to temperatures above 1,200 degrees C., as this would cause a permanent change in the resistance of their vital parts, necessitating recalibration. Their usefulness extends consequently over the whole range of annealing temperatures, but not high enough to be practical for measuring the temperatures of iron and steel, and their alloys in the molten state. The active portion of these pyrometers, consisting of a coil of fine platinum wire, must be protected against the action of furnace gases by an impermeable sheath or covering. And as there are no highly refractory substances which will accomplish this excepting some special porcelains or pure silica, which are all of a brittle nature, it stands to reason that these instruments must be carefully handled. This, however, is a feature present in all high-class temperature measuring instruments that are directly exposed to the sources of heat.

Thermo-electric Pyrometers compose another distinct class of modern high temperature measuring instruments. They are the simplest in construction, are easily handled, and easily applied, and can be used in numerous instances where it would be impossible to make use of pyrometers of any other type. The fact that almost any two metals of different natures or of different compositions, when joined, will cause the appearance of thermo currents upon heating this junction, has induced many enterprising firms to bring instruments of this kind upon the market. However, in the majority of

these the fact has been overlooked that the physical quality of changing heat waves into electrical waves alone, even if applied to practice by the most skilful mechanic, is not sufficient to produce a reliable scientific instrument for measuring temperatures. It is true, there are some that are quite trustworthy within specified limits, but for most of them entirely too much is claimed.

There are an amazingly small number of materials among the seventy odd elementary substances and their innumerable combinations that, when connected in pairs, will meet all the requirements of a good thermo-metric pyrometer. The best so far devised is that consisting of one wire of pure platinum and one of pure platinum alloyed with 10 per cent. rhodium as suggested by Professor Henry Le Chatelier of the School of Mines at Paris, France. It is considered by all physicists the standard of measurement for high temperatures up to about 3,000 degrees F., and it unquestionably supercedes all others in constancy and accuracy from about 300 degrees F. to its upper limit.

Among thermo-electric couples there may be further mentioned the iridium-ruthenium and the platinum-iridium couple. The former can be used for temperatures higher than 3,000 degrees F., but it is exceedingly brittle and therefore not well adapted for use in industrial works, though it is undoubtedly of a high scientific value. Platinum-iridium couples have a smaller range than Le Chatelier's platinum-rhodium couples. This is owing to a change of their thermo-electric constants which occurs at about 1,800 degrees F. on account of the volatilisation of the iridium that commences about at this stage. Trustworthy for lower ranges of temperatures are copper-constantan, silver-constantan, and iron-constantan thermo couples. (Constantan is an alloy of 60 per cent. copper and 40 per cent. nickel.) Neither of these latter couples, however, can be seriously recommended for use above 650 degrees C. or 1,200 degrees F.

Optical Pyrometers are constructed upon the laws of relationship between heat and light. They are in fact instruments that measure the degree of light that is emitted by a hot body, and this is transposed by some convenient means into degrees of temperature. But this property alone, if not combined with simplicity of construction, ease of handling and maintenance would not fill the requirements of every day shop practice. At the present time there are but few commercial optical pyrometers that possess these qualities combined, and most of them remain therefore so far only excellent laboratory instruments, which in the hands of a careful operator give surprisingly accurate results within ranges that are far beyond the reach of other instruments for the same purpose. There are, however, a few types of optical pyrometers made that are very simple in construction and easy of manipulation, which may be used by almost any man of ordinary intelligence. But it should not be forgotten that due allowance must be made in all optical pyrometers for personal errors of observation which vary sometimes considerably with different, and occasionally even with the same individual observer.

Radiation Pyrometers, like optical pyrometers, are used at a distance from the source of heat that is to be measured. They are therefore not subject to destruction by fire or furnace gases and will last indefinitely if guarded against mechanical injury. No part of the instrument is ever heated above 80 degrees C. or about 180 degrees F. Their construction is based upon the principle of measurement of the total radiations of heat—not light, as in the foregoing—of substances located under conditions known as those peculiar to a black body. The heat rays are collected by a mirror located within the instrument, and then concentrated into a focus where the hot junction of a sensitive copper-constantan couple changes them into electrical waves, the electromotive force of which is subsequently measured by a sensitive d'Arsonval galvanometer. The scale of this indicator is expressed directly in degrees Fahrenheit or Centigrade as the case may be, and there is no transition of the values into any other denomination necessary. This makes the instrument a very convenient contrivance for the direct determiation of the highest attainable temperatures.

Miscellaneous Pyrometers based upon the laws of expansion of air, the dilution of liquids and gases and the variation of the viscosity of gases—all under different conditions of temperature—have also been made, and have found some application in practice, but in a comparatively limited way only. The graduation of these instruments is purely empirical, as they are somewhat cumbercome, more or less complicated and expensive.

Fusible Alloys, made of precious metals, have been occasionally employed for the determination of high temperatures; but, excepting in dentistry, their application in practice has been almost entirely abandoned.

The equipment of all mechanical and electrical pyrometers includes necessarily a suitable indicating or recording device. Expansion and contraction pyrometers and thermometers have their mechanism for moving a pointer over a graduated dial directly connected to the operative portion of the end exposed to heat. The expansion and contraction of the substances which form the vital parts of these instruments furnishes ample power to admit a permanent contact of the writing pen with the paper without introducing material error. The result is, therefore, a continuous uninterrupted line which represents graphically the conditions of temperature with relation to time of the entire heating process. In electrical pyrometers a very small amount of power is available for moving a pointer over a scale and for recording the corresponding temperatures. Resistance pyrometers are used in connection with a Wheatstone bridge to determine the change in resistance of its sensitive portion which is dependent upon its temperature. Milli-volt meters serve mostly, in thermo-electric pyrometers, for the measurement of the electromotive force of the thermo-currents which in turn stand in certain relationship to the temperature prevailing at their points of junction. Radiation pyrometers which are also constructed upon the thermo-electric principle have the same means of measurement.

Recording instruments for these pyrometers embody the same electrical apparatus as their indicating instruments, and besides this a clock-work with paper and style imprint movements. In recording instruments for resistance pyrometers, subsidiary currents from batteries or motors may be used for furnishing any amount of power that may be necessary for the pen, paper, and imprinting movements. It is thus possible to produce uninterrupted continuous line diagrams on the record paper. In recording instruments for thermo electric and radiation pyrometers, however, we are solely dependent upon the feeble thermo-electric currents for operating the movable portions of galvanometers or millivoltmeters Permanent records can only be obtained by resorting to periodic depressions of the style bearing the indicating needle. In this manner the records become line drawings that are composed of consecutive markings, which, according to the specific arrangement used, may combine either

into a continuous line, or be represented by a series of dots which show continuity and dependency from each other in the completed diagram.

The advantage of continuous autographic records, which give a truthful and lasting representation of all details accompanying the entire course of a process of heat treatment can not be readily attained by the use of an indicating instrument alone, unless its indications are noted down at regular short intervals by a trustworthy employé who has been especially detailed for this purpose. Non-recording instruments, however, are a necessity in the hands of men in charge of furnaces or ovens. They serve as reliable guides furnishing information of existing conditions.

Application of Pyrometers.

The principal use that pyrometers find in malleable cast-iron foundries is for regulating the temperature of annealing ovens, and especially for regulating the temperature of the malleable castings themselves during the anneal. It has been pointed out that large variations in temperature are apt to occur at different portions of an annealing oven. Such a state once existing, it remains practically constant, unless adequate means are provided for to equalise the irregularities. It is but natural that the charge itself is subject to entirely different conditions. There is usually an enormous mass of cold material packed in suitable boxes, heaped up in the interior of the oven; these are arranged in several rows two or three high, and such a mass can not possibly be heated uniformly by ordinary methods. Such portions of the charge which are most exposed to the direct action of the hot gases must necessarily absorb a larger quantity of heat than others that are less exposed. The lower and central portion of the charge is least accessible to the action of the current of hot gases, the flow of which is usually directed from one side wall to the other of the oven. This is what retards the anneal and determines its duration. The heating of this portion of the charge is almost exclusively effected by the slow processes of conduction and radiation. The upper portions of the annealing boxes and their contents, however, are easily overheated should the firing exceed the admissible limit. These are conditions which can not be entirely avoided in ovens of large dimensions, but much may be done towards reducing the time of anneal by reconstructing the ovens, by changing the method of charging the ovens, and by accommodating the practice of annealing to suit these ends.

The selection of the place where a pyrometer should be introduced into an annealing oven, in order to obtain the most serviceable information as to prevailing conditions, is of considerable importance. At best no more should be expected from a good pyrometer applied under such conditions than a reliably correct indication of the temperature of a single part or section of an oven. It serves as a trustworthy guide to the temperature at particular places, and as the regulation of the fires must remain with the attendant, he is relieved from the responsibility of using his own judgment and from guessing at existing temperatures.

A far more radical method to ascertain and to follow the changes of the thermal conditions of an annealing process is to measure the temperature of the material itself. This may be connected at first with some difficulties, but it is by no means impractical. It is certainly the true way of proceeding if one would obtain positive results which may serve as a suitable basis to lay down iron-clad rules for the allowable maximum limitations of our heating process. The writer is not aware that this has ever been attempted in malleable iron practice, but he had the opportunity to assist in developing some methods after this principle for the annealing of sheet steel.

In applying such methods to the annealing of malleable iron it would suggest itself that the temperatures of the hottest and the coldest portions of the charge be followed up regularly; and as we should be informed of the respective temperatures of the malleable iron castings themselves, our measurements should be taken at the interior of the annealing boxes. This can not be done unless a few—say two or three—boxes of each charge are specially fitted up for the purpose. The arrangement does not require anything elaborate. A suitable rigging would be an iron or steel tube half as long as the width of an annealing box, secured to its interior opposite a corresponding opening left in its side, of which it forms a continuation, extending inwardly like a thimble. The inner end of this tube must be closed, and the outer one may be provided with a flange which can be held in place against the inside wall of the annealing box by a wedge that fits between ribs, arranged for the purpose. The joint between box and flange of the thimble is luted with fire-clay to prevent air and gases of combustion from entering. These test boxes are arranged in such a manner that the described thimble-like tubes stand in alignment with observation holes left in the walls of the annealing oven. The thimbles themselves are arranged as nearly as possible in a horizontal position for all types of pyrometers excepting for those constructed after the radiation principle, when they should incline upwardly with their inner closed end, so that a line drawn from here through the observation hole of the furnace wall will fall with its outer end about 5 or 6 in. lower.

Any suitable form of pyrometer is then introduced into the interior of these boxes, or the telescope of a radiation pyrometer is focused to the bottom of the thimble, and the indications received will be the temperatures that prevail at these particular places, and not those of the furnace or of the surrounding furnace gases.

The above dwells especially and specifically on the application of pyrometers in annealing practice, and apparently with good reason, as it is in this particular process where these instruments undoubtedly find the most extended use, and it is here where they should prove of the greatest value if properly applied. But aside from this there are many opportunities for making good use of them at other places in a malleable iron foundry. It is not the intention, however, to enter here into the details of such varied applications. It is not at all likely that the temperature in an annealing oven is uniform throughout, though in some exceptionally good instances—as in pit furnaces—there may exist no greater variations than 50 degrees F. in its various portions. This, however, is a rare occurrence; it is found more frequently that different portions of the same oven vary from 100 to 300 degrees F. and upward. The first application for pyrometers is in equalising the temperatures in the ovens as closely as may be. Prevailing conditions are reliably indicated by applying one or more pyrometers at different portions of the installation, and such conditions being once established and known, it becomes an easy matter in the hands of a practical furnace man to regulate his oven temperatures by enlarging some of the flues or by chocking others, by opening or closing dampers, by increasing or decreasing the supply of fuel or air, or

the draught in the stack, by luting up cracks in the walls or around the doors, and in other ways for which no set rules can be given, but which will readily suggest themselves in practice.

In connection with the above it may be appropriate to call attention to a mistake which is frequently made when pyrometer readings are taken of furnaces of this or any other description. That is, such readings are usually taken for granted as representing the true temperature of the furnace, regardless of the fact whether the flame of the fuel plies against the sensitive portion of the instrument or not. This is wrong, and apt to lead to grave errors. The pyrometer should be exposed to the direct action of the flame if it is the intention to ascertain the temperature of this, but its direct influence must be guarded against, if we wish to establish the state of the interior of our furnace. As it takes rarely more than a fraction of a minute to take such a reading, it will prove safest to turn off our fires while making tests of this nature.

The best method of annealing consists in heating the charged material as quickly as possible to the maximum temperature compatible with the process, keeping it at this stage for a sufficient length of time to effect the desired molecular change and then letting it cool down slowly. A considerable saving in time and in fuel may be effected by pushing the firing in the first stages to its upper limit, provided due care is being taken to make full use of the heat derived from the combustion of the fuel for heating the charge, and not sending it out of the stack.

It should require but little argument to convince the user that the same equipment or the same fittings of a pyrometer are rarely suitable for temperature measurements of metallurgical processes that are of different natures or which are conducted in furnaces of different construction or design. The variety of their applications, to which reference has been made, should present sufficient reasons why it is impossible to devise a single universal form that would prove equally convenient and equally serviceable under all conditions. And as the success to be derived from the use of these instruments depends largely upon their form, their fittings and their equipment, which must be specially adapted to the particular use for which they are intended, it is always advisable to leave the selection of the apparatus in the hands of a specialist in such matters.

A Novel Core-making Machine.

By Thomas Walker.

The writer was confronted some little time ago with the difficulty of getting cores quick enough from the core department, the number wanted being about 460 per day, the cores in question being for sash weights.

The small margin of profit on this class of casting would not allow of much time being spent on them, or of much time being lost in lifting the tops on and off to core up. Four boys were engaged in making the cores, and with the system of jointed core-boxes one core required two minutes to make.

The accompanying illustrations show a machine which was rigged up, and which served the purpose very well. It may here be mentioned that this machine was not originally intended for a core machine, it having served the purpose of a meat chopper at some time.

The only alterations necessary to make this machine a practical and useful tool in the core department were the guide brackets A, Fig. 2, and the guide block B, to which was attached one-half of the core-box. As will be observed, the core-box is shaped as near the shape of the core as possible, and the edges filed to a knife edge. The machine is so adjusted that the edges of the core-box just touch when the block is down. The action is a plunger-like motion, and is geared 4 to 1, giving four smart blows to one revolution of the handle. With this machine a boy makes fifteen cores a minute; no vents are necessary in this type of core when a loose open sand is used. This machine was also used for the small stopping over cores, seen in the illustration, and at present a core-box for small taps and valves is being designed. There is no difficulty in placing wires or vents in cores made in this manner, all that is necessary to place the vent in the core is to release the spring at back of machine, so that the two halves of core-box remain closed, when the wire can be forced through a suitable opening at the print ends of the core-box. Fig. 3 illustrates the machine prior to its conversion to a core-making apparatus.

FIG. 1.

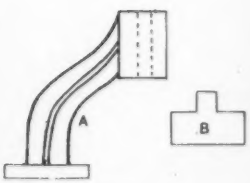


FIG. 2.

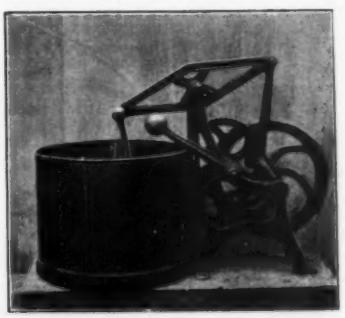


FIG. 3.

A NOVEL CORE-MAKING MACHINE.

Cast Iron Gutters.

The manufacture of roof gutters, or rhones, in cast iron has become an important branch of general foundry work, therefore some notes upon the subject may be of interest. Gutters may be broadly classified as follows:—(1) half-round; (2) ogee; (3) ornamental or moulded; (4) boundary wall; (5) valley; (6) box; and (7) tapered. Sections of the first six are shown in Figs. 1 to 6. Tapered gutters are usually of the boundry wall, valley, or box forms, and derive their name from the fact that they are made with a "run" or self-contained fall towards the outlets. Cast-iron gutters are usually made in 6 ft. lengths, the faucet or spigot being extra to this size, and are connected together in various ways, the more common of these being outside faucet, inside spigot and flange joints, shown in Figs. 7, 8 and 9 respectively. Each of these methods of fixing have their advantages and disadvantages. The first method (Fig. 7) has the advantage of a clear and uninterrupted passage for the water inside the gutter. Its disadvantage is that the formation of the joint on the outside detracts from its appearance (see Fig. 10). In the second method (Fig. 8), the case is just reversed; it has the advantage of an unbroken line on the outside, whereas the flow of the water is interrupted by the formation of the joint inside (see Fig. 11). The third arrangement (Fig. 9), is that used for gutters of a heavy section, where strength is required; a strip $\frac{3}{8}$ in. or $\frac{1}{2}$ in. in width is carried along the outside face of the flanges, as shown, leaving a space about $\frac{1}{16}$ in. or $\frac{1}{4}$ in. in width for caulking. Provision on flanged gutters should always be made that the caulking may be done from the inside of the gutter. Fig. 12 shows an arrangement of flange joint which should be avoided, as the caulking must be done from the outside, and in many cases this is impossible.

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 6.

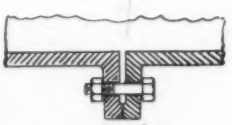


FIG. 9

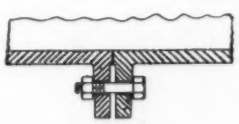


FIG 12

FIG. 7.

FIG. 8

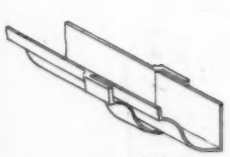


FIG 10

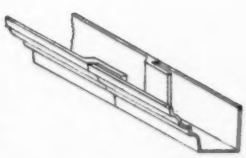


FIG.11

Contraction.

One of the primary considerations in a pattern is to make the necessary provision for contraction, so that the work when cast will turn out perfectly true to size and shape. To provide for this a great deal more has to be considered than merely the addition of $\frac{1}{8}$th or $\frac{1}{10}$th of an inch per foot on the pattern. The pattern must be so constructed according to its shape and cross sectional area, as to prevent the work when cast being bent and otherwise out of form. Contraction is regulated in some degree by the percentage of silicon in the iron. In irons containing a high percentage of silicon the contraction is low, and as the silicon decreases the contraction increases. In general practice, however, the chemical constituents of the iron are seldom considered when either determining the allowance for contraction or the construction of the pattern to counteract the effect of contraction. The practical man, as a rule, knows nothing of the component parts of iron; therefore his rules for contraction are of a rough and ready character, based usually on the size, form, and thickness of the casting. In thin castings more contraction is allowed for than in the case of thick ones, for the quicker the iron cools the greater is the contraction. Green-sand castings will contract more than drysand castings, and work cast vertically less than either.

In addition to the amount of contraction necessary for certain classes of work, its effect must also be

Table of Camber for Gutters, Cornices, and similar work of a Channel Section.

DEPTH OF GUTTER IN INCHES	METAL $\frac{1}{8}$" THICK.	METAL $\frac{5}{32}$" THICK.	METAL $\frac{3}{16}$" THICK.	METAL $\frac{7}{32}$" THICK.	METAL $\frac{1}{4}$" THICK.	METAL $\frac{5}{16}$" THICK.	METAL $\frac{3}{8}$" THICK.	METAL $\frac{7}{16}$" THICK.	METAL $\frac{1}{2}$" THICK.	DEPTH OF GUTTER IN INCHES
	Camber.	Camber.	Camber.	Camber.	Camber.	Camber.	Camber.	Camber.	Camber.	
$1\frac{1}{2}$"	$\frac{1}{8}$"	$\frac{11}{32}$"	$\frac{27}{64}$"	$\frac{53}{64}$"	$\frac{25}{32}$"	$\frac{21}{32}$"	$\frac{25}{64}$"	$\frac{29}{64}$"	$\frac{3}{8}$"	$1\frac{1}{2}$"
2"	$\frac{63}{64}$"	$\frac{15}{16}$"	$\frac{59}{64}$"	$\frac{61}{64}$"	$\frac{3}{4}$"	$\frac{5}{8}$"	$\frac{33}{64}$"	$\frac{7}{16}$"	$\frac{23}{64}$"	2"
$2\frac{1}{2}$"	$\frac{31}{32}$"	$\frac{27}{64}$"	$\frac{13}{16}$"	$\frac{49}{64}$"	$\frac{23}{32}$"	$\frac{39}{64}$"	$\frac{1}{2}$"	$\frac{37}{64}$"	$\frac{11}{32}$"	$2\frac{1}{2}$"
3"	$\frac{59}{64}$"	$\frac{27}{32}$"	$\frac{25}{32}$"	$\frac{33}{32}$"	$\frac{43}{64}$"	$\frac{9}{16}$"	$\frac{15}{32}$"	$\frac{25}{64}$"	$\frac{21}{64}$"	3"
$3\frac{1}{2}$"	$\frac{7}{8}$"	$\frac{21}{64}$"	$\frac{47}{64}$"	$\frac{11}{16}$"	$\frac{41}{64}$"	$\frac{35}{64}$"	$\frac{29}{64}$"	$\frac{3}{8}$"	$\frac{5}{16}$"	$3\frac{1}{2}$"
4"	$\frac{53}{64}$"	$\frac{41}{64}$"	$\frac{45}{64}$"	$\frac{21}{32}$"	$\frac{39}{64}$"	$\frac{33}{64}$"	$\frac{27}{64}$"	$\frac{23}{64}$"	$\frac{19}{64}$"	4"
$4\frac{1}{2}$"	$\frac{25}{32}$"	$\frac{37}{64}$"	$\frac{21}{32}$"	$\frac{39}{64}$"	$\frac{9}{16}$"	$\frac{31}{64}$"	$\frac{13}{32}$"	$\frac{11}{32}$"	$\frac{9}{32}$"	$4\frac{1}{2}$"
5"	$\frac{47}{64}$"	$\frac{43}{64}$"	$\frac{5}{8}$"	$\frac{37}{64}$"	$\frac{17}{32}$"	$\frac{29}{64}$"	$\frac{3}{8}$"	$\frac{5}{16}$"	$\frac{19}{64}$"	5"
$5\frac{1}{2}$"	$\frac{11}{16}$"	$\frac{5}{8}$"	$\frac{37}{64}$"	$\frac{17}{32}$"	$\frac{1}{2}$"	$\frac{27}{64}$"	$\frac{23}{64}$"	$\frac{19}{64}$"	$\frac{1}{4}$"	$5\frac{1}{2}$"
6"	$\frac{41}{64}$"	$\frac{19}{32}$"	$\frac{35}{64}$"	$\frac{1}{2}$"	$\frac{29}{64}$"	$\frac{25}{64}$"	$\frac{21}{64}$"	$\frac{9}{32}$"	$\frac{15}{64}$"	6"
$6\frac{1}{2}$"	$\frac{19}{32}$"	$\frac{35}{64}$"	$\frac{1}{2}$"	$\frac{29}{64}$"	$\frac{27}{64}$"	$\frac{23}{64}$"	$\frac{5}{16}$"	$\frac{17}{64}$"	$\frac{7}{32}$"	$6\frac{1}{2}$"
7"	$\frac{35}{64}$"	$\frac{1}{2}$"	$\frac{15}{32}$"	$\frac{27}{64}$"	$\frac{25}{64}$"	$\frac{21}{64}$"	$\frac{9}{32}$"	$\frac{15}{64}$"	$\frac{13}{64}$"	7"
$7\frac{1}{2}$"	$\frac{1}{2}$"	$\frac{29}{64}$"	$\frac{27}{64}$"	$\frac{25}{64}$"	$\frac{11}{32}$"	$\frac{19}{64}$"	$\frac{17}{64}$"	$\frac{7}{32}$"	$\frac{3}{16}$"	$7\frac{1}{2}$"
8"	$\frac{29}{64}$"	$\frac{27}{64}$"	$\frac{25}{64}$"	$\frac{11}{32}$"	$\frac{5}{16}$"	$\frac{17}{64}$"	$\frac{15}{64}$"	$\frac{13}{64}$"	$\frac{11}{64}$"	8"
9"	$\frac{13}{32}$"	$\frac{3}{8}$"	$\frac{11}{32}$"	$\frac{5}{16}$"	$\frac{9}{32}$"	$\frac{1}{4}$"	$\frac{7}{32}$"	$\frac{3}{16}$"	$\frac{5}{32}$"	9"

NOTE—The figures given in the above table are for patterns on which there are two contractions allowed. The patterns from which the castings are made should have HALF the amount given in the table.

taken into consideration, for since this contraction is not always regular, on account of the form and weight of the different parts of the casting, it is liable to result in the casting turning out mis-shapen. In the case of gutters cast in a straight mould the castings would probably turn out bent, and to counteract this the patterns must be made with a camber, the amount of which is regulated by the length and cross-sectional area of the work. In order to assist foundrymen dealing with work of this nature we have compiled a table showing what may be taken as the average amount of camber necessary for the various sections of gutters and work of a similar nature.

It may be pointed out that the figures given are what the writer has found from practice to be fairly correct, but as will be explained later, the ramming of the mould materially affects the amount of camber; therefore, it may happen that two moulders, if given the same pattern, may turn out castings of a different degree in straightness, the one moulder requiring more or less camber on his patterns than the other. A great deal may be done by an intelligent moulder to assist in overcoming the difficulties met with in this class of work. If the work after being cast is found not "true," the moulder can, by judicious ramming of the mould both before and after the work is cast, and also by altering the position of the pouring gates, in many instances save the re-making of the pattern. This treatment, of course, is only possible after a trial casting has been made. For instance, if it is found there has been an insufficient amount of camber allowed on the pattern, the moulder may, by heavily ramming with a flat rammer the sand at the ends of the box, prevent to some extent the casting rising, and in this way make the work turn out straight.

Great care must also be observed regarding the manner in which this class of work is run. The pouring gates should be arranged to give an equal amount of metal on either side; for should the pouring gate be placed too near the front or back, the work will turn out hollow on the side nearest to that on which the gates are placed.

The Pattern Material and the Patterns.

Let us now give some consideration to the material which is used in the construction of the patterns, viz., plaster of Paris. This material, or stucco, as it is more commonly called in the foundry, has of late years taken a very prominent place among the materials used in the construction of patterns, and in no branch is more applicable than to the class of work under discussion. Stucco is a valuable material for patterns, as its plastic nature renders it suitable to be shaped into practically any form, and its readiness to set into a hard substance enhances its value. Plaster of Paris is prepared from gypsum by reducing it to the anhydrous state by calcination at a temperature not exceeding 120 degrees Centigrade. The physical property upon which its great utility depends is its readiness to "set" or harden when made into a paste with water.

When working with stucco the following points should be observed:—(1) The box or basin used for mixing should be well oiled, and have its sides well tapered to allow the easily removal of the hard unused stucco; (2) the hands should also be oiled before starting to mix; (3) in mixing stucco the water should first be put into the mixing basin, and the stucco powder added afterwards, the proportion of stucco and water being about equal; (4) a little Irish lime

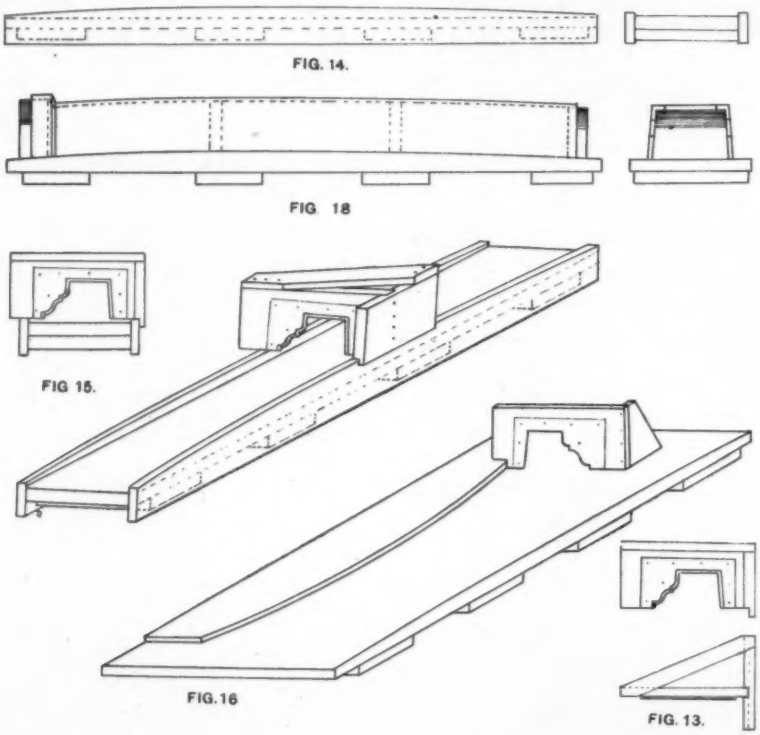


FIG. 14.

FIG. 18

FIG. 15.

FIG. 16

FIG. 13.

should be mixed with the water before the dry stucco is added, the lime being added to reduce the tendency of the stucco to swell; (5) as swelling is an important factor in stucco work, the work should be finished with as little delay as possible, as the "thickness" is apt to tear off if the gauges are worked too long.

There are several methods of preparing gutter-patterns, but we will confine ourselves to one of these, from which good results are obtained without entailing any apparatus of a costly nature. In the first place, two zinc gauges are required, one cut to the shape of the inside and the other the outside of the required section of the pattern, and these are screwed to a wooden frame, as shown in Fig. 13. A turning-over board a little longer and broader than the size of the pattern is now required; on to each side of this is secured a strip about ¾-in. thick, and from 3 in. to 4 in. broad. The top edge of each of these strips is curved to the amount of camber required on the pattern (Fig. 14). The turning-over board is now temporarily fixed to a bench, the soft stucco laid on the track of the gauge, and the gauge is moved along from right to left until the work is

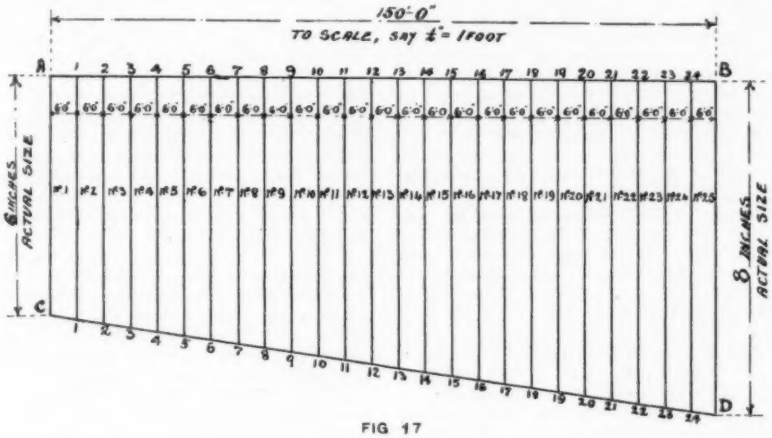


FIG 17

brought into shape (Fig. 15). When the block is complete it is varnished with shellac and methylated spirits, oiled, and the inside gauge is removed from the wooden frame leaving the outside gauge. The same operation is performed with the outside gauge, and with it the thickness is run on. The joint is added, and the thickness cut into parts about a foot long, this for reasons of convenience. The work, when varnished, is ready to pass to the moulder.

In the foregoing we have only dealt with straight gutters. We will now briefly consider circled gutters. These are made in lengths of 3 ft., 4 ft., and 6 ft., according to their radii. The pattern for a circled gutter is "run up" similarly to that of a pipe bend, a template is made to the curve, and the gauge is held against it and worked round its contour, as shown in Fig. 16.

The turn-over board on which a pattern for a circled gutter is run up requires to be prepared with a camber, as the effect of contraction has to be guarded against in circular, as well as in straight gutters.

Patterns for Tapered Gutters.

We will now consider the preparation of the patterns for tapered gutters. These gutters, as has been already stated, are made with a self-contained fall towards the outlets; that is, the depth of the gutter is greatest at the point where it discharges. This is a class of gutter which causes a certain amount of trouble, as the pattern requires to be altered after each length is cast. Let us assume that a stretch of gutter is required 150 ft. long, and a fall of 2 in. is wanted on the entire length; the size of the gutter at the discharging end being 12 in. wide and 8 in. deep, and at the other end 12 in. wide and 6 in. deep.

The procedure for this class of work is as follows:—Procure a drawing-board and draw a line AB (Fig. 17) the length of the stretch, viz., 150 ft. to any convenient scale, say, ¼-in. to a foot. From the point A draw AC 6 in. long (actual size), and from B draw BD 8 in. long (actual size), AC and BD being at right angles to AB. Then divide the line AB into twenty-five parts, each part 6 ft. long to scale, being the length of each piece of gutter; draw lines at right angles from each of the dividing points till they meet the line joining the points C and D, and number each as shown in the diagram (Fig. 17). In this diagram we have the actual depth at each end of every 6-ft. length of gutter in the stretch, just as though the work had been drawn out to the full length of 150 ft.

The method of preparing the patterns for tapered gutters is as follows:—Corner-pieces, sides, and bottom plates are cast to suit the shallowest pattern, and a turning-over board is prepared with bridges at intervals, as shown in Fig. 18. When this is done, thin strips of wood are nailed on to the top of the bridges, the thickness of each strip being equal to the difference between the length from A to C and the length I to I. When twenty-four of these strips are nailed on each bridge the greatest depth will be reached. The space left in the pattern between the side and corner plates is filled up with a strip of wood and the pattern is then ready for the moulder.

After the first casting, which should be marked No. 25, is made, the top strip is removed leaving twenty-three strips on each bridge. The side, corner, and bottom plates are now put in position. The strip of wood filling up the space between the side and corner plates will require to be reduced in width every time a strip is taken from the bridges. When the top strip has been removed, and the plates are in position, the pattern is ready for casting No. 24, This process is continued throughout until No. 1 is arrived at, when the original block will be reached, from which the last casting, viz., No. 1, will be cast.

With the other sections—boundary wall and valley gutters—the process is similar, and does not require separate explanation.

Fluxes for Melting Iron.

By M. Albutz.

The author proposes herewith to give some information as regards the chemical action and influence of fluxes in cupola melting. The enquiry has been put as to the utility of blast furnace slag as a flux when used for melting in the cupola, also as to the effect it would have on light castings if used either with or without limestone or other fluxes.

To use blast furnace slag as a flux is absolutely detrimental in every case, whether used for light or heavy castings; whether charged quite by itself, or in conjunction with other fluxes. The only and great objection is because there is no blast furnace slag to be found which contains less than 15 per cent. to 20 per cent. of silica (SiO_2).

It would be interesting to know from what economical point of view blast furnace slag should be used for melting in a cupola. The conception that it would be profitable to use slag from the blast furnaces (which otherwise would be carried away as refuse) instead of buying good limestone, is just as mistaken as the expectation that re-melting the blast furnace slag in the cupola in order to reduce some of the iron oxide (FeO) to iron, would prove of advantage or profit. Slag, as it occurs by melting in the cupola, is a natural product, and possesses quite sufficient fluxible character without adding any special fluxes, by reason of the silica, which is always present in the form of sand or in the ash of the coke, and, further, through the presence of FeO, which occurs after pig-iron has attained a sufficiently high temperature. The iron oxide so obtained easily combines as a basic substance with the very effective acid SiO_2, which is, as already mentioned, in the form of sand, adhering to the pig-iron, $SiO_2 + FeO = FeO\ SiO_2$; *i.e.*, a basic silicate of iron is produced.

The slag so obtained, without adding any fluxes, is of a more or less pasty nature, and in the ordinary course of cupola melting would soon accumulate to such an extent as to make effective working and pure cast iron an absolute impossibility. Therefore it is necessary to find another substitute for FeO, so as to make even the larger quantities of slag very easily fluxed and to remove the same, as required, by being drawn off through the slag hole.

One of the most effective fluxes and the one mostly used is limestone, especially carbonates of lime ($CaCO_3$). Limestone should be as pure as possible and absolutely free from sulphur, and should under no circumstances contain more than 2.5 per cent. of silica (SiO_2), because either in form of sand or as an ingredient of limestone, every ounce of silica serves no other purpose than to produce an excessive and unnecessary amount of slag, at the same time absorbing a certain amount of heat, and consequently more coke is burnt in order to melt the same quantity of iron.

As a good sample of limestone may be considered:—

CaO	=	50 per cent. to 53 per cent.
CO_2	=	42 per cent. to 45 per cent.
SiO_2	=	.25 per cent. to 1 per cent.

also a very small percentage of H_2O, P_2O_5, Fe_2O_3.

In order to know the fairly approximate quantity of limestone necessary to obtain an easily fluxible slag in the cupola which will not absorb too much heat, it is of the utmost importance to find out those substances which are actually slag producers, *i.e.*, the substances which produce slag as a natural product without adding any fluxes. Such substances are:—

(1) Sand and other earthy matters adhering to the pig-iron to be charged.

(2) The ash of the coke, which has much the same composition as clay, consisting chiefly of silica (SiO_2), silicate of alumina ($A_2O_3 : 2\ SiO_2$), oxide of iron (FeO), lime (CaO), magnesia (MgO), also small amounts of alkalies.

(3) Oxide of iron, which owes its presence partly through conversion of pig-iron into oxide of iron and partly through oxidisation of the iron, the latter being continually in contact with the oxygen of the blast.

Now, being familiar with the substances which produce a natural slag, *i.e.*, a slag which is obtained without using any fluxes at all, but which is in a more or less pasty state and, therefore, difficult to separate from the pure iron, it is essential to know the exact quantity of fluxes necessary to make the slag fluxible enough to be easily drawn off through the slag hole. In order to do this we must be acquainted with (1) the percentage of sand adhering to the pig-iron and scrap; (2) the percentage of ash in the coke; and (3) the chemical composition of the fluxing medium, at least, the percentage of silica and lime. For instance, if the flux is to be limestone, it is evident that as soon as the percentage of the constituents of this material (other than CaO) increases, a larger amount of limestone has to be used, but always bearing in mind never to allow any increase in SiO_2 as soon as same has reached 2.5 per cent.

Before going thoroughly into the calculation as to the amount of fluxes required, it would be advisable to concentrate our attention on the chemicail actions which are taking place during melting. In both cases, *i.e.*, in melting with or without fluxes, the chemical process is simply a combination of basic *and acid* substances at a certain temperature.

(*a*) *Without Using any Fluxing Material.*—Here we have, on the one hand, as an acid substance, silica (SiO_2) in the form of sand adhering firmly to the pig-iron and scrap, also a certain amount of SiO_2, as found in the ash of coke. On the other hand, we have a basic substance in iron oxide (FeO) which, however, is not so powerful as lime (CaO), and has a very great affinity to silica.

$$\text{Slag} = (SiO_2 \cdot FeO) = FeSiO_3$$
$$SiO_2 \quad \cdot \quad FeO$$
$$\text{(acid substance)} \quad \cdot \quad \text{(basic substance)}$$
$$SiO_2 + FeO = FeSiO_3$$

that is to say, a combination of silica and iron oxide will take place, forming a silicate of iron. (Of course, there are several other basic substances in small quantities, mostly found in the coke ash, such as alumina (Al_2O_3), and carbonate of potassium, but their percentage is so small as to be overlooked, and as regards Al_2O_3, this has very little affinity for silica, and may be considered as of neutral character).

$$SiO_2 + FeO = FeSiO_3,$$

or

$$60 + 72 = 132,$$

or 60 parts of SiO_2 require 72 parts of FeO; one part of SiO_2 requires 1.2 parts of FeO, which is equal to $^{56}/_{48} = 0.93$, say one part of iron. Therefore, it will be seen, by using no flux, but simply having FeO as a basic substance the amount of iron lost in the slag is about equal to the amount of silica charged into the cupola; accordingly the use of blast-furnace slag would result in absolute failure.

This shows furthermore the great advantage to be gained from charging pig-iron free from sand, either machine cast or direct from the blast furnace into channelled cast-iron beds instead of into sand beds. Although machine cast pig-iron is chilled to some extent as it appears from its fracture, its chemical composition is so far unchanged.

(*b*) *Slag Obtained by Using Fluz.*—As already mentioned, the fluxing material is in most cases supposed to be either carbonate of lime $CaCO_3$ or lime CaO, the latter being obtained by subjecting limestone to a certain temperature, after the following formula:—

$$CaCO_3 = CaO + CO_2.$$

Here we have again silica on the one hand as an acid, whilst on the other hand we have as a basic substance calcium oxide or lime CaO, and also to some extent FeO.

If the fluxing material is charged in the form of limestone it is soon decomposed by the heating action of the ascending gases; the CO_2 escapes through the stack, whilst the descending lime combines with the silica to a silicate of lime.

$$CaO + SiO_2 = CaSiO_3$$

There are a number of chemical combinations which are taking place in this case.

First Stage.—$CaCO_3 = CaO + CO_2$, *i.e.*, limestone is reduced to lime and carbonic acid driven off.

Second Stage.—$CaO + SiO_2 = CaO\ SiO_2$ or $CaSiO_3$. This is actually the first combination which takes place on account of lime being such a strong basic substance and having a great affinity to silica, and no other combination of importance will take place at the moment as long as silica and lime are present in proper proportions.

Third Stage.—$FeO + SiO_2 = FeSiO_3$ or $FeO.\ SiO_2$. This combination takes place either through not providing sufficient lime to combine with the silica or through an excessive oxidation of iron to iron oxide owing to the metal being too much exposed to the action of the blast.

Final Stage.—$CaO + FeS = CaS + FeO$; *i.e.*, should there be a slight excess of CaO still left uncombined with the silica the former will easily take up all the sulphur which owes its presence either as an ingredient of the pig-iron or of the coke, and it would be possible to obtain an iron almost free from sulphur, but the amount of limestone necessary to keep the slag of a basic character would be too large in comparison with the amount of coke used.

As already shown, slag is produced from oxidation of silicon, manganese and iron of the metals to be melted, from the adhering sand and pig-iron, further from the fluxing material charged, and also from the ash in the coke. Some typical analyses of cuplon slag are given in the following:—

	SiO_2	Al_2O_3	FeO.	MnO.	CaO.	MgO.	S.	Ca.
I.	56.1	11.5	15.3	3.50	9.75	0.60	0.17	0.23
II.	45.2	11.6	9.9	1.16	15.52	0.49	0.22	0.28
III.	50.4	10.6	20.9	4.0	9.80	0.74	0.18	0.22
IV.	46.7	9.3	7.3	2.79	31.6	0.15	0.40	0.50

The above table shows, as already stated, the action and influence of the acid and basic agencies, *i.e.*, SiO_2 as acid on the one hand and CaO and FeO of basic character on the other hand, and furthermore it will be observed that by a decrease of silica we have at once an increase of either FeO or CaO, whilst Al_2O_3 varies very slightly.

Example.—To find the approximate amount of limestone necessary to melt one ton of iron under the following conditions:—

Metal charge: ½ ton of pig-iron, ½ ton of scrap (runners, bad castings).

Coke charge: 2 cwts. per ton of iron melted.

Considering those substances from which slag is produced we have the following:—

Sand adhering to pig-iron = 30 lbs. per ton of iron.

Sand adhering to scrap = 40 lbs. per ton of iron.

or per charge of 1 ton, $\frac{30}{2} + \frac{40}{2} = 35$ lbs.

Amount of ash in coke = 7.5 per cent.

or per charge $2.2 \times 7.5 = 15$ lbs.

Amount of silica in 15 lbs. = say 10 lbs.

Further, we have an oxidation of Si, Mn and Fe or what is called burnt iron, which amounts in the case of Si to about 0.20 per cent., or say, about 5 lbs. per ton of iron, and the loss of burnt iron through oxidation of Fe and Mn another 5 lbs; so we obtain:—

Slag producing substances from—

	Lb.
Adhering sand ... ... =	35
Ash in coke ... ... =	10
Through oxidation ... ... =	10
Total ... ... =	55

This 55 lbs. is actually a slag-producing substance and consists almost entirely of silica or of similar composition of great affinity to limestone, and therefore we derive the following chemical formula:—

$SiO_2 + CaCO_3 = (CaSiO_3) + CO_2$.

$60 + 100 = 116 + 44$.

Or 60 parts of SiO_2 require 100 parts of $CaCO_3$.

Or 1 part of SiO_2 requires $\frac{100}{60} = 1.66$ parts of $CaCO_3$.

Or 55 lbs. of SiO_2 require $55 \times 1.66 = 90$ lbs. $CaCO_3$.

Limestone required for 1 ton of iron = 90 lbs. $CaCO_3$.

Should lime (CaO) be used in place of limestone ($CaCO_3$) we obtain the following:—

$SiO_2 + CaO = CaSiO_3$, or $60 + 56 = 116$.

60 parts of SiO_2 require 56 parts of CaO.

1 part of SiO_2 requires $\frac{56}{60} = 0.9$ parts.

or 55 lbs. of $SiO_2 = 55 \times 0.9 = 50$ lbs. of CaO.

The limestone used here has the following composition:—

$SiO_2 = 1.5$ per cent.

$CaCO_3 = 98.5$ per cent.

The percentage of SiO_2 is so small that this has very little influence on the melting process, and limestone may be considered as pure $CaCO_3$, and 56 lbs. of CaO has just the same effect as using 100 lbs. of $CaCO_3$.

THE KEIGHLEY ELECTRICAL ENGINEERING COMPANY, of the Vulcan Works, Keighley, which concern is owned by the Keighley Corporation, are considering enlarging their plant to 3,000 h.p., by adding two 1,000-h.p. turbine generators.

MESSRS. SAMUEL LUND & SONS, of the Midland Foundry, Keighley, have received an order from the East Indian Railway Company for a multiple drilling machine with six drills, and two milling machines. The length of the bed is 40 ft.

The Pickling of Castings.

By L. T.

Now that the modern machine tool is so much in vogue, it is more than ever imperative that castings should have an acid dip, if the full benefits from these tools are to be obtained. All castings, when they leave the foundry, are more or less covered with sand and a black oxide scale, both of which are most injurious to cutting tools, quickly wearing them away.

The injury thus caused is most keenly felt when machining operations are done with repetition tools to produce interchangeable pieces, as these necessarily require setting up, adjusting and grinding by an expert hand. These precision tools are always very expensive and the scale or sand on castings has a disastrous effect on them, as well as absolutely preventing high-speed milling, if due respect is paid to the milling cutters. It has been claimed that the life of a cutter is prolonged as much as six times by introducing pickled castings instead of operating on material direct from the foundry. In actual practice it will be found that the cost of production is considerably reduced, and this saving has been known to be as much as 25 per cent. Pickling, therefore, is not to be despised, but apparatus for that purpose should be properly installed in all factories where castings are machined in quantities.

Building.

The building should preferably be apart from, or outside, the main building, and with a plentiful air supply, as the fumes given off during the operation of the process are very obnoxious. A lean-to is convenient, as this is open altogether on one side, the roof being made of some non-corrosive material, such as glass and wood.

It is a good plan to arrange the tanks below the floor level, to simplify the handling of the castings, and when dealing with small castings in bulk, trays or boxes are very useful, the bottoms of the same being perforated for draining off the liquor. The tanks should be lead-lined, and the trays can be made of hard wood. It is hardly necessary to state that arrangements should be made for draining the tanks, and that access for cleaning them should be easy. The space around the tanks should preferably slope towards a fairly large drain, as a good flush of water is required to wash the castings after immersion in the acid. A sloping platform should extend backwards from each tank to enable the liquor to drain off the castings, back again into the tanks, before the final wash.

The Solution.

The strength of the solution varies considerably and depends on the length of the immersion required. A cheap solution that is recommended consists of 1 part of sulphuric acid to 10 parts of water, or similar proportions, using hydrofluoric acid. In this bath the castings would have to remain for a period of about 10 to 12 hours, and in working the process this can easily be arranged to take place during the night. If a quicker process is desired the solution may be strengthened accordingly. The activity of the pickle is increased somewhat by raising the temperature to about 70 degrees to 80 degrees F., which can easily be done by the introduction of a little steam. Care should always be taken to introduce the acid to the water, the solution being stirred during this operation.

It will be found in actual practice that the mixture will keep active for some considerable time if the strength is kept up by the addition of more acid from time to time. The writer has known 40 gallons of acid to last for one month, and pickle during that time 60 tons of small castings.

Action of the Acid.

The action of the acid is to produce a corrosion on the part attacked, the rate of which varies according to the degree of concentration. Sand, or the various iron oxides, which are always formed on castings, are what it is necessary to remove, but the acid solutions have very little effect on this sand or iron oxide; the work is done by attacking, to a large extent, the iron that underlies this outer surface, the latter being then deposited as a sediment in the bottom of tank or removed by mechanical means.

Process.

On receiving the castings from the foundry after they have been fettled, tumbled, and perhaps sand-blasted, they are taken to the pickling department and immersed in the tanks for a period long enough to remove the outer skin and loosen the sand. As to this stage, the discretion of the operator must be depended upon, and it rests with him whether a success or failure is made of the process. The exact strength of the mixture and the period of immersion must be found out by experience.

It will be noted that on taking the articles from the pickle, the outer surface has a spongy appearance which must be removed by washing in water; this is best done by a jet from a hose pipe. Plunging the castings in water is not sufficient to remove this spongy surface.

If cold water is used, the castings will dry slowly and be quickly covered with rust. This is not injurious if the castings are used immediately, but if it is desired to prevent rusting, a more elaborate process must be gone through, such as washing in a hot solution containing a small amount of potash or soda, of about 200 degrees F

Special care should be taken to thoroughly clean intricate castings containing hollows or recesses, to make sure that all the solution is washed out of same. If not, the acid is apt to continue its action and eat into the metal.

The operator should be suitably guarded against the action of the acid on his person, and a good plan is to provide him with cheap clogs, a rubber apron, and rubber gloves, as well as goggles for the protection of his eyes. It is also expedient to rub vaseline on the hands as an extra safeguard, before using the gloves.

DAVY BROTHERS, LIMITED, of Sheffield, have granted a licence to the United Engineering and Foundry Company, of Pittsburg, U.S.A., to manufacture the company's high-speed forging presses for use in the United States, Canada, and Mexico, and a considerable amount of business is already being done by the Pittsburg Company under this agreement. The boiler department at Messrs. Davy Brothers' works has taken up the manufacture of the Atlas patent balanced draught, which is stated to be giving very remarkable results in steam raising and economy in fuel.

Factories and Workshops Report for 1908.

The annual report of the Chief Inspector states that the number of registered factories and workshops at the close of the year was 260,089, including 376 institution factories and workshops under Section 5, 1907, but excluding 25,110 entries of men's workshops. This shows an increase of 2,896, as compared with the previous year. The figure for 1908 includes 110,691 factories and 149,398 workshops. The number of works under regulations and special rules was 11,066, an increase of 480 on the year. Abstracts and other papers were issued to new occupiers of 341 textile factories, 7,794 non-textile factories, 20,046 workshops (including men's and domestic workshops), and 691 other premises; or 28,872 in all. The formal notices and reports received from occupiers, certifying surgeons and others numbered 462,784, including 122,912 notices of accidents and "dangerous occurrences," 193,935 overtime reports, and 32,609 humidity records. The inspectors forwarded to District Councils 6,510 formal representations and 16,752 notices of occupation of workshops; the corresponding figures for 1907 being 6,833 and 17,254. In addition to other written instructions and correspondence, 136,518 notices of contravention of the Acts were sent to occupiers, as compared with 87,567 in 1907.

Ventilation.

On the subject of dust and ventilation, the report states that in nearly all districts very considerable progress has been made in the extraction of dust by exhaust ventilation, and particulars are given of some very efficient systems that have been erected. There are few dusty processes now in any kind of manufacture in which it has not been tried with very beneficial results; at the same time instances of defective arrangements are frequently met with owing to want of proper design or adjustment of the ducts and fan. Mr. Redgrave (Midland Inspector) refers to the great improvements effected by these means in metal-grinding shops in the Birmingham district, improvements which have not only benefited the health of the workers, but have also been appreciated by the employers themselves. In no district is the question of dust more important than in Sheffield, and, with a view to improving the condition of grinders in the cutlery trades there, a conference was held with representatives of the employers and workers, as a result of which draft regulations were drawn up and are now under consideration. Fans or other artificial means are also extensively used for ordinary ventilation, or for carrying off fumes and gases generated by manufacturing processes. This has been partly brought about by the facilities with which electric power can be now obtained.

Accidents.

On the subject of accidents, the report remarks that higher speed, increased use of machinery, and better reporting have all had a tendency of recent years to keep up the number of recorded accidents, and to obscure to a certain extent the fact that working conditions as regards machinery are relatively safer now than they were some years ago. To these causes also is no doubt due the fact that in certain districts there has been no marked decrease in the number of accidents reported, notwithstanding the depressed condition of trade and the amount of unemployment that existed during 1908.

The changes in the law introduced by the Notice of Accidents Act, 1906, are not yet properly understood, and, comparatively speaking, very few "dangerous occurrences," *i.e.*, certain accidents without injury to persons, have been notified. The attention of occupiers, however, is constantly being directed to the new requirements, both verbally and by letter, and, where necessary, by prosecution. Referring to this subject, Mr. Redgrave (Midland Inspector) points out that a number of accidents due to cuts and scratches, which are of daily occurrence in large works, and so slight as not to interfere with work for more than an hour or so at the time, now become reportable under the Act, because, owing to want of care or proper dressing, inflammation or blood poisoning is often set up, and causes prolonged absence from work at a later period. In this connection he urges the affixing of notices directing workers receiving such injuries to go at once to the accident room or man in charge of "first aid" for proper examination and treatment, which is generally provided now in most large works.

Attention is drawn to the danger of overhead cranes in large engineering and boiler works owing to the sound of their approach being drowned by the noise in the shops. Mr. Wilson (Glasgow), observes that accidents caused by men being crushed are on the increase, partly due to the use of electric cranes, which are much more silent in their movements. Gongs, bells, and other warning appliances have been tried, but he thinks that a powerful electric light at each end of the travelling carriage would have greater effect.

A good deal has been done in providing efficient guards on emery wheels, but it is recognised that for certain kinds of work so much of the wheel must be exposed that guards are of little use. Mr. Arbuckle (Sheffield) supplies a comprehensive table giving particulars of grindstone and emery wheel breakages during the year in that district. Forty-six cases of fracture occurred. Twenty-five workmen were injured, one fatally. Extra softness of the stone is usually given as the case of a breakage. As a rule, grinders prefer soft stones because they work easier, but they have to be run faster than hard ones, and do not possess the same strength. The maximum speed allowed for a stone in Solingen is 2,953 ft. per minute, and it is interesting to note that of those that burst in Sheffield last year only four were running at a speed of less than 3,000 ft., and several ran at speeds of 4,000, 5,000, and 6,000 ft. per minute.

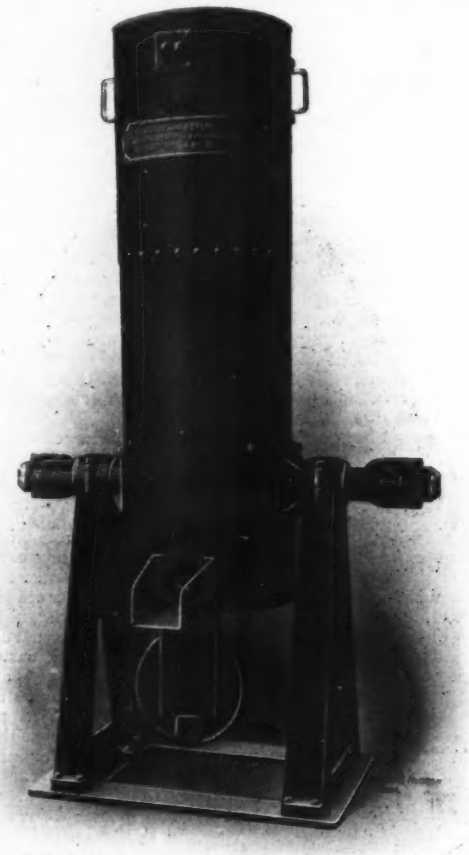
Referring to accidents at blast furnaces, the report remarks:—"A very serious explosion occurred in a blast furnace in the Leeds district, whereby five men were killed and thirteen injured. Shortly before the accident the furnace was noticed to be 'hanging,' that is to say, a 'scaffold' or crust was forming on the side and preventing the material descending properly to the bottom. The usual steps were taken to dislodge this, when immediately the explosion occurred. Explosions of this kind are not uncommon now in ironworks, due, it is thought, to the high temperature of the blast, and various methods have been tried to prevent them. In view of the seriousness of this case, special enquiries are being made in other districts with the object of ascertaining what precautions are possible."

MESSRS. L. S. D'ISZORO and J. B. URIE, manufacturing and consulting engineers, Stockport, trading under the style of the Aqua Engineering Company, have dissolved partnership.

A Small Whiting Cupola.

The accompanying illustration shows the smallest size in which the Whiting cupola is manufactured. The diameter of the shell is 27 in. and the total over all height is 10 ft. The cupola is mounted on trunnions through which the blast pipe is carried. It will be seen that the cupola may be readily turned to a horizontal position when cleaning or relining are necessary.

This cupola has been specially designed for test purposes, and it is particularly suitable for technical



A Small "Whiting" Cupola.

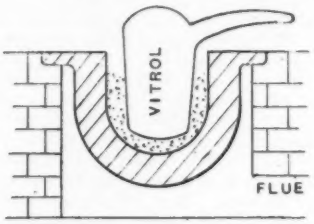
schools and for use as a general portable cupola for emergency or repair work. It will be noticed that it has a stack of much more liberal proportions than is usual in cupolas of similar type, thereby rendering it a more rapid melter and more economical in fuel consumption. This cupola, which is known as the "Whiting No. 0," is made by Messrs. J. W. Jackman & Company, Limited, of London, Manchester, and Glasgow, who also manufacture under licence other sizes of the Whiting cupola up to a capacity of 20 tons per hour.

By an outbreak of fire on the premises of Messrs. Adams & Company, engineers, 35, Pitt Street, Glasgow, recently, damage was done to the extent of about £100.

Queries.

Heat-resisting Cast-iron Pans.

We make for a chemical works some cast-iron pans that have to stand a great heat, but they do not last more than a few weeks, whereas, we are informed,



they used to, and should now last as many months. Can you tell us how to overcome this, and what kind of iron to use? The pans are of 2-in. metal, as shown, and the vitriol vessel which they contain are of glass, and bedded in river sand.

"C. W. R."

Metal for Valves.

We are using for steam valves and cocks the following mixture:—Copper, 80; tin, 2; zinc, 12; lead, 6; one-third of this being re-melted metal. We are, however, having trouble with porous castings. Can you suggest a remedy?

"Ochil."

Replies.

Cupola Troubles.

If the drawing given is approximately accurate, the cause of the trouble is at once shown, the tuyeres being on the same level. It also appears that the air pressure is too great, as a blower taking 7 h.p. should not be needed for so small a cupola. An 18-in. cupola when fan-driven only requires a No. 3 Sturtevant fan

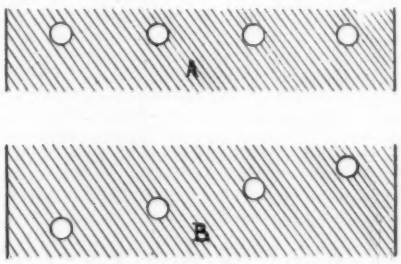


Fig. 1.

running at roughly 3,500 revolutions per minute, if the tuyeres are of sufficient size and the run in from fan to furnace is a straight one, an air pressure of from 10 in. to 12 in. being used to ensure that the penetration to all parts of the fuel is secured. Such a fan can be steadily run by means of a 3-h.p. "Stockport" or "Crossley" engine with power to spare, and the use of a 7-h.p. engine to blow an 18-in. cupola seems to the writer to indicate a big waste, whatever form of air propellor is used.

Assuming the tuyeres in the case mentioned by "C. W. R." to be on the same level, the air blows against itself, and eddies and circles around causing the fire to "blow cold," as the firemen of the old school say, and a reference to A at Fig. 1 will show that this can readily occur. If, however, the tuyeres are on different levels, as shown at B, the air from each has its own free course across the furnace—except, of course, for the fuel against which the blast impinges—and the furnace, with nothing above the tuyeres in the form of slag or other interruptions,

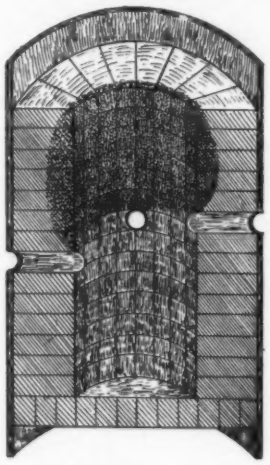


FIG. 2.

"blows hot," eventually taking the form shown by the dark shading in Fig. 2. The lining burns away in the melting zone principally, the other parts retaining practically their original shape. The part around and just above the tuyeres should be lined with very durable bricks, such as "Battersea" bricks, and with small cupolas a band of from 2½ ft. to 3 ft. in height should be put in, but with large ones nearly the whole height from the hearth or "bottom," to the charging door should be so faced.

As the best results in melting are secured by giving a large volume of air at low pressure (*i.e.*, only just enough pressure to force the air through the charge)

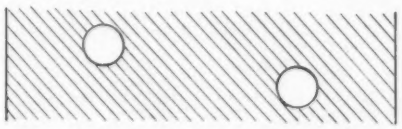


FIG. 3.

tuyeres of large area should be used, and up to 20 in. diameter two 6-in. tuyeres will be sufficient if on opposite sides of the furnace, and one above the other, as shown in Fig. 3, this arrangement giving an ample air supply for iron if the fan or blower will send it along in sufficient quantities. The combined area of two 6-in. tuyeres is roughly 56½ square inches, while that of four 3-in. tuyeres is only 28¼ square inches, or just half that of the two larger ones, therefore pressure must be much more on the smaller tuyeres to pass the same amount of air through them as can be passed through the larger ones, this additional pressure affecting the metal brought down very considerably.

Generally speaking, when furnaces go wrong or do not behave properly after being altered, it is good policy to take the advice of someone who understands the matter and can personally inspect the place, as very frequently there are points of importance which are not mentioned in written queries, and these may determine the whole matter.

"W. J. M."

It appears to me that you are fusing the lining of your cupola by having too much blast pressure. To find the tuyere area divide the area of cupola by 9.

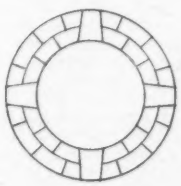
$$\text{Area of cupola } \frac{254.49}{9} \text{ sq. in.} = 28.27 \text{ sq. in.}$$

Area of 4¼ tuyeres 14.18 sq. in.

Therefore two tuyeres 4¼ diameter are ample, and at the end of the blast main pipe a regulating valve should be fixed. If you have no wind gauge you will soon be able to judge the pressure required by its effect on the lining and the rate your metal comes down. You should melt a ton per hour.

"R. F. W."

There is one of two things wrong with the cupola mentioned by "C. W. R." Either the pressure is too great, or the tuyeres are too small. In the former case the speed of the engine should be reduced. The tuyeres should measure, if round, 5½ in. diameter on the inside of the cupola and 4 in. on the outside; if of the square type they should taper out from 4 in.



square to 4 in. by 7 in. on the inside of the furnace. As it is at present the coke is fusing under pressure and setting up dross, which accumulates where it is coolest, namely, on the edge of tuyere. A No. 2 blower is much too powerful for a cupola of the dimensions stated; a fan would suit the purpose better, the blast being more elastic besides being more economical in fuel. The remedy suggested is sketched herewith.

"T. W."

Paint for Foundry Roof.

In reply to "F. H.," graphite is to be recommended as a pigment for all kinds of iron work. It it anti-corrosive, rendering the usual first coat of red-lead superfluous. Colours of dark varieties can be procured by mixing it with pigments of red, white, yellow, or light green. Being finely ground, it mixes easily with boiled oil (to which should be added the usual drying stuff), and it is easily and economically worked.

WILLIAM OLSEN,
74, Cogan Street, Hull.

A suitable dark iron-grey coloured paint for the sheet-iron roof of the foundry is Dixon's silica-graphite paint, of which we are the manufacturers in Great Britain.

"GRAPHITE PRODUCTS, LIMITED,"
218, 220, Queen's Road, Battersea, S.W.

Inventions.

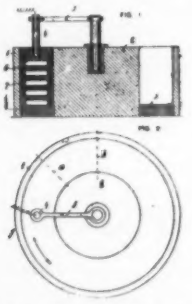
Applications for Patents.

An asterisk indicates that a complete specification accompanies the application. When inventions are communicated the names of the communicators are in brackets.

14,430.*Automatically regulating furnace draught. G. de Grahl.
14,468. Moulding machines. J. B. Neesham, 100, Wellington Street, Glasgow.
14,683. Weigh-bridges. W. E. Hipkins, Soho Foundry, Birmingham.
14,814. Stoves, kilns, muffles, etc., for drying moulds, etc. L. A. Smallwood, 5, Corporation Street, Birmingham.
14,858. Electric furnace electrodes. C. Bingham.
14,869. Manufacture of patterns for casting, and casting of screw-threaded articles, etc. T. H. D. May, 139, Queen Victoria Street, London.
14,937.*Electrical induction furnaces. C. Grunwald.
15,183.*Producing from foundry iron a metal product having cutting and other properties of high grade tool and high speed steel. E. A. Custer.
15,384. Alloys. R. D. Mackintosh, 2, Norfolk Street, Strand, London.
15,400.*Furnaces for uniformly heating metals. W. N. Best, E. Best, and J. H. Best.
15,857. Furnaces. W. F. Goodrich and W. R. Hamlyn.
15,882*Manufacture of hollow castings. W. Kurze, 37, Furnival Street, Holborn, London.
15,988. Manufacture of steel. A. Reynolds.
16,169. Furnaces for heating steel, iron, etc. S. Onions and W. T. Baker, 6, Lord Street, Liverpool.
16,210.*Metallic alloys. Kunheim & Company.
16,240.*Heating and melting furnaces. W. N. Best, J. H. Best, and E. Best.
16,242.*Abrasive metal-cutter. (Walter Wyman Slack, United States.) E. C. R. Marks.

Abstracts of British Patent Specifications recently accepted.

10,378 (1908). *Electric Furnaces.* E. Cornelius, Trollhättan, Sweden.—The characteristic feature of the furnace, which is horizontal or substantially horizontal, consists in its operating chamber being annular, so that charging, heating and discharging of the substance can be effected simultaneously and continuously, and the heating place can be changed successively around the operating chamber. For the changing one of the electrodes is movable, so that it can easily be moved around the operating chamber. Fig. 1 is a vertical section of the furnace, and Fig. 2 is a plan view of the same. The bottom part 3 is of carbon, and forms one of the electrodes. The opposite electrode 4 is composed of a rod carried vertically by means of an arm 5 from a support located centrally of the part 2, so that by giving the arm 5 angular motions of adjustment the electrode 4 can be moved from one point to another around the annular operating chamber of the furnace. The electrode 4 should be carried from the rod 5 so that it can be adjusted vertically, and it should be fitted with a suitable conductor for supplying electric current. The substance to be treated is charged into the furnace at *a* (Fig. 2), and the product resulting from the operation is discharged at *b*.



Cornelius Electric Furnace.

11,824 (1908). *Ingot Moulds.* H. S. Moorwood and J. M. Moorwood, Harleston Iron Works, Sheffield.—This invention has for its object the strengthening of ingot moulds made of cast-iron. Fig. 1 is a side elevation of a strengthened ingot mould; Fig. 2 is an end elevation, and Fig. 3 a plan of the same. Before casting the ingot mould, the inventors place in the annular space of the mould, into which the molten metal is run, a core, *a*, made of a stronger or more ductile material and run the body of the casting round it. This core is made of steel or wrought iron plate which is embedded in the solid metal wall of the ingot mould. This plate may be in one solid piece, bent to the form of the casting, or it may be in any number of bent pieces and may be plain or perforated or embossed as shown by the dotted lines *b*, *b*, Figs. 1 and 2, in order to make it secure in the cast metal. Instead of the strengthening core being in the form of a flat plate or plates, it may be made up of separate pieces of bars of high tenacity of any suitable section embedded in the solid cast metal. The strengthening core need not necessarily be of steel or iron, but may be of any material of high tenacity suitable for embedding in cast metal.

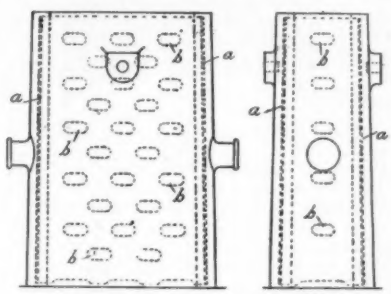


FIG. 1. FIG. 2.

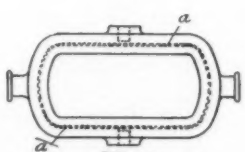
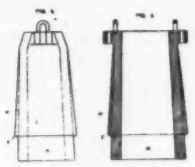


FIG. 3.

Moorwood's Ingot Mould.

16,709 (1908). *Ingot Moulds.* T. Williams, works manager of the West Hartlepool Steel Works, and the South Durham Steel and Iron Company, Limited, Stockton-on-Tees.—Figure 1 is an end elevation, and Figure 2 a sectional elevation cross-wise thereto, of an ingot mould, constructed in accordance with the in-

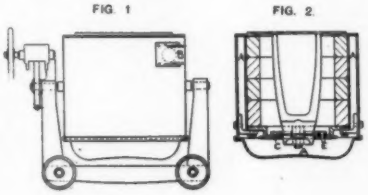
vention. The lower part *a* of the mould is made the usual thickness, according to local practice, but at a distance from the bottom of about one-fifth (more or less) of the total length of the mould a shoulder *b* is formed by increasing the thickness of the metal, say, by about two inches; this increased thickness gradually decreasing towards the top, where it is of normal size. The essential point is the thickening gradually down to the shoulder *b*, as shown, the dotted lines *x* indicating the normal thickness of the walls of the ingot



Ingot Mould.

mould when made according to the hitherto usual practice, which results in prolonging the life to a very considerable degree, and experiments with moulds constructed according to the invention have proved this to be the case in a most satisfactory manner, the liability to crack and other causes of failure being reduced to a minimum, thus obviously reducing the cost, trouble, and delay in connection therewith. Although the increase of thickness is shown in the form of a shoulder, it is obvious that a sharp taper or angular form would serve the same purpose, which is to increase the strength of the mould, where the strain is found to be greatest.

20,424 (1908). *Tilting Crucible Furnaces.* J. Newton and C. Billington, Vulcan Works, Longport, Stoke-on-Trent.—Integral with the upper surface of the bottom plate, and around its central circular hole, is formed two annular walls of equal height and thickness, at a suitable distance apart, with a number of holes through the plate. By thus controlling the direction of the air blast, the wear of the crucibles is reduced. Figure 1 is a side elevation of the furnace, showing the way it is

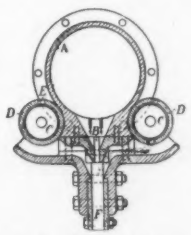


Tilting Crucible Furnace, by Newton & Billington.

mounted; Figure 2 is a section of same showing air space, grid, and annular walls; Figure 3 is an inverted plan of the furnace with bottom cover removed, showing the grid and annular walls of same in dotted lines made in two parts, also the method of fixing same to furnace. A is the air space, and when at work air is forced into the space by means of a blower or fan through branch B, and from air space into the furnace through holes C between annular rings E E.

17,759 (1908). *Heat Treating and Quenching Alloyed Steels.* J. Churchward, 127, North 7th Avenue, Mt. Vernon, State of New York, U.S.A.—This invention has for its object to provide an improved process for use in the production of alloyed steels whereby the resultant product is rendered of extraordinary toughness and hardness. The invention consists, broadly, in subjecting the metal to a series of heats or heat-waves of successively decreasing maximum temperature, designed to affect the alloying metals in the order of their respective retardation points, the first heat or heat-wave being carried to a temperature preferably a little below the retardation point of the alloying metal having the highest retardation point, that is, well into the recalescent period. Such first heat or heat-wave may be carried to a temperature a little below the segregating point of the alloying metal having the highest segregating point without departing from the spirit and scope of the invention; then rapidly cooling or quenching in a suitable manner at all of these temperatures. Each successive heat or heat-wave is carried to a point a little below either the segregating or retardation points of the corresponding alloying metal, the mass being rapidly cooled or quenched after each successive heat or heat-wave. It may be explained that as the steel alloy is heated and the temperature is being raised towards the segregating point of one of the alloys in the steel alloy, the point of commencement of absorption is first reached; the metal is then heated through the recalescent period, or period of absorption, to the retardation point or point of total absorption. Above this point is a period of rest or inactivity of the particles, and above this again is the segregating point or point where the alloying metal commences to leave the molecule again and separate around it in the form of films.

22,246 (1908). *Sand-blast Apparatus.* (Communicated by Badische Maschinenfabrik & Eisengeisserei vormals G. Sebold und Sebold & Neff, of 22, Karlsruher-strasse, Durlach, Grand-Duchy of Baden, Germany.)—This invention relates to a slotted nozzle or discharge pipe for sand-blast apparatus, in which the sand is fed by a worm conveyor inside a feed pipe, which extends along the entire length of the nozzle, and is provided with outlet holes for the sand along the length of the nozzle. The special feature of this invention is the combining in the nozzles of the sand feed pipe with the discharge nozzle so as to form a combined whole, with the object of rendering it possible for such slotted nozzles to be employed or built into rotary cleaning drums. This improved slotted nozzle may therefore be employed in



Improved Sand-Blast Apparatus.

a suitable and convenient manner in rotary cleaning drums, and thus affords the advantage of a uniform distribution over the entire contents of the drum, without it being necessary to employ the ordinary small movable nozzles, which render the operation intricate, and necessitate the pipes for air and sand being made movable. The invention has also for its object to allow the supply of sand to such nozzles to be immediately stopped, without it being necessary to stop the worm or worms in the sand feed pipe. This object is attained by the sand feed pipe being made revoluble, care being taker to provide for the free discharge of the sand which the worms, which continue to work, bring forward during the stoppage of the sand blast. The annexed cut is a vertical section of the apparatus.

Trade Talk.

IZONS & COMPANY, LIMITED, West Bromwich, are altering and extending their Albion Works.

MESSRS. JAMES E. SAYERS & CALDWELL have removed to new offices at 190, West George Street, Glasgow.

MESSRS. LEWIS OLRICK & COMPANY, LIMITED, engineers, have moved to 16, Howick Place, Westminster, S.W.

MESSRS. BLAKEBOROUGH & COMPANY, engineers, Brighouse, are adding a large pattern-shop to their works.

EVERED & COMPANY, LIMITED, of Surrey Works, Smethwick, near Birmingham, have closed their Barnet Works, Devonshire Street, Birmingham.

MESSRS. WILLIAM ELDER & SONS, Tweedside Implement Works, Berwick-on-Tweed, have begun business at Hardgate Street, Haddington.

AN issue has been made of 200,000 £1 preference shares in Ruston, Proctor & Company, Limited, engineers and boilermakers, Lincoln.

A DESTRUCTIVE fire occurred in the moulding shop and a tin shop of the hydraulic department of the Shropshire Union Canal Company on July 2.

MR. F. C. MOORWOOD, 7, East Parade, Sheffield, has been appointed agent for Messrs. A. Johnston & Company, iron and steel makers, Avesta, Sweden.

MESSRS. F. EVANS and J. EVANS, malleable ironfounders, etc., Walsall, Staffs., trading under the style of John Evans & Sons, have dissolved partnership.

MESSRS. F. S. CHRISTIE and W. Lampitt, engineers, Slacklewell Lane, Hackney, N.E., trading under the style of Christie and Lampitt, have dissolved partnership.

THE CAMELON IRON COMPANY, LIMITED, of Falkirk, have appointed Mr. W. H. Herbert, 140, Bryn Road, Swansea, as their agent for Wales and the West of England.

THE STAVELEY COAL AND IRON COMPANY, LIMITED, have secured several large orders of late, including one for about 6,000 tons of castings for the Lincoln new waterworks scheme.

A DISSOLUTION of partnership is notified in connection with Messrs. G. E. Priddle and W. Heppell, general engineers, etc., Warner Street, Clerkenwell, E.C., who traded under the style of Priddle & Heppell.

MESSRS. H. G. MAYER & COMPANY, 67, Aldersgate Street, London, E.C., have been appointed agents for the Maerkische Drahtwerke, for the finer sizes of copper, bronze, and brass wire, from No. 17 to 50 S.W.G.

WM. BEARDMORE & COMPANY, LIMITED, of Glasgow, are making extensive additions at their Parkhead Works in order to provide accommodation for the manufacture of mountings for guns up to 13.5 in. calibre.

IN the debenture holders' action against Robert Stephenson & Company, Limited, of Newcastle, heard on July 9 last by Mr. Justice Warrington, Mr. Peat, of Darlington, was appointed as receiver and manager.

MESSRS. J. BEARDSHAW & SON, LIMITED, of the Baltic Steel Works, Sheffield, have just appointed Messrs. W. A. Walber & Company, 38, Victoria Street, Westminster, their agents for London and the South of England.

THE business of the late Mr. Robert Rice, metal refiner, 61, Commerce Street, Aberdeen, has been acquired by Messrs. Robert Rice & Company, and will be conducted in future by Mr. William Robertson, the former manager.

MR. A. L. YOUNG, carrying on business as a copper founder and nail manufacturer, under the style of Young, Dowson & Company, College Court, Hammersmith, W., and Emmett Street, Poplar, E., has been adjudged bankrupt.

EDWARD LOMER & COMPANY, LIMITED, of 110, Fenchurch Street, London, E.C., notify us that Mr. Hubert Ruegenberg, of Olpe, Westphalia, has transferred to them his agency for the United Kingdom for the sale of high carbon forged steel balls of which he has for many years made a speciality.

THE Japanese section of the Japan-British Exhibition, to be held at Shepherd's Bush next year, will be divided into 18 groups, including education, mechanical engineering, electricity, civil engineering and transportation, mines and metallurgy, chemical industries, various industries, armament, etc.

THE co-partnership carrying on business as engineers at 169, Finnieston Street, Glasgow, under the name of the Finnieston Engineering Company, of which Mr. A. Mackellar and Mr. J. E. McArthur were sole partners, has been dissolved by the retiral of Mr. McArthur. Mr. Mackellar will continue to carry on business under the same name.

In the House of Commons, last month, in reply to MR. MIDDLEMORE, MR. MCKENNA said that a trial order for guns had already been placed with the Coventry Ordnance Works, and that when the need arose, the question of the desirability of placing an order for heavy gun mountings with the firm would be considered.

THE creditors of John Purden & Sons, Lambhill Forge, Maryhill, Glasgow, and Peter Purden, Ironbank Villa, Lambhill, a partner, have been informed by Mr. David Strathie, 162, St. Vincent Street, Glasgow, the trustee, that the commissioners have postponed the declaration of a dividend till the recurrence of another statutory period.

MESSRS. CLEGG & HOWGATE, of Lawholme Lane, Keighley, have recently very considerably enlarged their works, and have installed a large sand-blast apparatus for cleaning castings. The company received the Admiralty order for mitre wheels and other castings in connection with the watertight doors for H.M. ships "St. Vincent" and "Neptune."

THE co-partnery of Hannay & Higgins, milling engineers, Stranraer, of which Mr. Henry Higgins, Mr. Andrew Hannay, and Mr. Alexander Craig were the partners, has been dissolved as at December 31, 1908. The business will be continued by Mr. Andrew Hannay and Mr. Alexander Craig under the same style, and they will discharge the liabilities.

WILLIAM HUNT & SONS, THE BRADES, LIMITED, Brades Steel Works, Oldbury, are installing an improved type of gas-fired furnace, by Messrs. William Kirkham & Sons, for heating shovel moulds. The furnace is being made double for continuous working, but it will also be possible, should necessity arise, to work either side independently of the other.

AT a meeting of the shareholders of the Furnace Specialists' Company, Limited, held at Glasgow, recently, a resolution was passed to the effect that the company could not by reason of its liabilities continue its business, and accordingly that the company be wound up voluntarily. Mr. James Myles, Junr., C.A., 150, Hope Street, Glasgow, was appointed liquidator.

AT Workington, recently, the engineering works and foundry, the property of E. J. Raybould & Company, Limited, known as the Marsh Side Works, Workington, were offered for sale by auction. There was a large attendance. Bidding commenced at £500, and rapidly increased to £1,200, at which price the works were sold to Mr. J. Hunter, of Whitehaven.

ON July 1 the use of electric power in factories and workshops became subject to regulations issued by the Home Office under the Factory and Workshops Acts. It is, therefore, incumbent on all occupiers of factories to make themselves familiar with these regulations, as there are certain possibilities not only of penalties, but of injunction against the use of electricity at the instance of a third party.

MR. JOHN ROBINSON, residing at Artana, Westfield, Rutherglen, sole partner of the firm of John Robinson & Company, mill and engineers' furnishers, 250, Abercromby Street, Glasgow, has granted a trust deed on behalf of his creditors in favour of Mr. Hugh Muir, chartered accountant, 11, West Regent Street, Glas-

gow. Messrs. Yuill & Kyle, writers, 79, West Regent Street, Glasgow, are agents.

NEGOTIATIONS have been concluded for the transfer of the main portion of the business of Messrs. J. E. Gibson & Company, Salton Iron Works, Falkirk, to the Coalbrookdale Company, Limited, Coalbrookdale, Shropshire, and the work will be carried on by that firm at their foundry in Coalbrookdale. This will involve the closing of Salton Foundry, which was established by the late Mr. J. E. Gibson, about twenty years ago.

AT a meeting of the directors of Palmer's Shipbuilding and Iron Company, Limited, recently, it was decided to dissolve the Shipyard Management Committee, consisting of Mr. A. M. Palmer, Admiral Cleveland, and the Hon. Robert James. For some years the gentlemen mentioned have represented the board of directors in the personal direction of the shipyard, but for the future the responsibility will rest entirely upon the new general manager, Mr. A. B. Gowans.

IN view of the increase of business in their large gas engine department, and of their intention to take up the direct sale of their Diesel oil engines in England, the Maschinenfabrik Augsburg-Nurnberg A.G., hitherto known in England as the Nuremberg Company, have terminated their agency agreement with Mr. J. Halcrow, 18, Coleman Street, London, E.C., and have opened an office in London. All communications should in future be addressed to the company, 219, Caxton House, Westminster, S.W.

As briefly notified in these columns a few months back new premises are to be erected in a suitable position in Sheffield for the use of the Government Inspectors of steel. The total expenditure will only be £7,000, of which £1,000 is to be expended during the first year. The existing premises in Surrey Street are too small for the work now being done, and when they are extended it is proposed to add to that work the testing of materials used in guns and their mountings, which has hitherto been done at Woolwich.

THE WITTON-KRAMER ELECTRIC TOOL AND HOIST COMPANY, of Witton, Birmingham, have recently acquired the entire goodwill of the business of Kramos, Limited, of Locksbrook Engineering Works, Bath, including their patterns, designs, patents, and trade marks. The Company are carrying on the manufacture of similar specialities to those of Kramos, Limited, adding improvements in the construction of mono-rail-electric hoisting machinery, electro-lifting magnets, brake magnets, and portable electric tools.

A MEETING of the creditors and debenture holders of Matthew Reid & Company, Limited, ironfounders, the Forge, Kilmarnock, was held recently, Mr. McNaughton, of the Lanarkshire Steel Company, presiding. Mr. Matthew Mitchell, Glasgow, submitted a balance-sheet showing the state of the Company's affairs at the date of his appointment by the shareholders as liquidator. The chairman moved that Mr. Mitchell's appointment as liquidator be confirmed. and that in the circumstances it was not necessary to appoint any person jointly with him. This was unanimously agreed to.

AT the annual meeting of the Institution of Gas Engineers, held in London, recently, the President, Mr. T. Glover, of Norwich, made the interesting announcement that the endowment fund of £10,000 for the Sir George Livesey Professorship at Leeds University was practically complete. The decision of the Institution to found a Professorial Chair of Gas Engineering at Leeds is in effect the carrying out of a cherished plan of Sir George Livesey himself, and one which, had he lived, would undoubtedly have taken shape. The choice as to which University should have the distinction of being the first to possess a chair of gas engineering was an easy one for the Council of the Institution, seeing that Sir George himself had indicated in unmistakable terms his preference of Leeds for this particular purpose.

THE International Agricultural Exhibition of 1910 to be held in the grounds of the Argentine Rural Society at Palermo (Buenos Ayres), will be opened on June 3, 1910, and closed on July 31 of the same year. As usual in such exhibitions, one section will be devoted to exhibits of machinery and implements. Entries and application for space should be made on the printed forms which the Secretariat of the Exhibition will furnish to all persons who may apply for them at the offices of the Rural Society at Palemor, or to the Argentine Legations and Consulates abroad. Entries and applications abroad can be presented at the Argentine Legations and Consulates General on the same dates and under the same conditions as any others. Applications for space in the machinery section will be received up to November 1, 1909.

THE Lords Commissioners of His Majesty's Treasury have appointed a Committee to advise the Departments of the Government, with a view to promoting uniformity of administration and co-operation between departments in dealing with the fair wages clauses of Government contracts. The Committee will consist of Mr. G. R. Askwith (Chairman), Comptroller-General of the Commercial, Labour and Statistical Departments of the Board of Trade; Mr. R. Bailey, Controller of the Stationery Office; Mr. F. W. Black, Director of Navy Contracts; Mr. W. G. Butler, Director-General of Stores, India Office; Mr. H. D. De la Bere, Director of Army Contracts; Mr. P. H. Ezechiel, Secretary to the Crown Agents for the Colonies; Mr. J. H. Hillier, Comptroller of Supplies, Office of Works; Sir G. C. V. Holmes, Chairman of the Board of Works, Ireland; Mr. G. Morgan, Comptroller of Stores Department, General Post Office. Mr. J. J. Wills, of the Board of Trade, will act as Secretary to the Committee.

THE new engineering laboratories of the Manchester University were formally opened last month by Sir Alexander Kennedy. The Vice-Chancellor (Dr. Hopkinson) was in the chair and Sir William Mather, Mr. J. A. F. Aspinall, and Professor Petavel were among those on the platform. The new building comprises four connected sections. The main block contains a number of lecture-rooms, including accommodation for the School of Architecture, two drawing offices on the top floor, private rooms for the staff, and the Osborne Reynolds Research Laboratory. Behind the main block is the hydraulic and testing laboratory. The testing section includes machines varying from those suitable for simple elasticity experiments up to a 100-tons Buckton testing machine. Water at heads up to 200 ft. is available in the hydraulic department, and in addition to a number of Mather-Reynolds and Gunther hydraulic turbines and pumps there is a large open flume suitable for work in connection with the flow of water over weirs and along natural and artificial channels. The engine and boiler department has two boilers of the locomotive and water-tube types, with superheater, economisers, and natural and forced draught. They supply steam to two sets of experimental engines. In a room adjacent to the boiler-house is a small Crossley oil engine and a gas engine which together with a suction producer, was presented by the National Gas Engine Company.

New Catalogue.

SLOAN & DAVIDSON, LIMITED, Carrick Foundry, Stanningley, Leeds. We have received from this firm the first portion of a new catalogue they are issuing. The varieties of the firm's products which are shown in this section include rain-water pipes and fittings of all descriptions, gutters of every size and form in use, manhole covers, cast-iron windows, pavement lights, spiral stairs, etc. It may be mentioned that in addition to those goods illustrated the firm make railings and gates, covered ways, verandahs, balconies, park shelters, columns and spandrils, lamp pillars and brackets, and all descriptions of light and ornamental ironwork.

New Companies.

J. S. PICKERING, LIMITED.—Capital £1,000 in £1 shares. to carry on the business of hoisting and general engineers, etc.

MOTLEY & GREEN, LIMITED.—Capital £5,000 in £1 shares. to acquire the business carried on at 33, Kirkstall Road, Leeds, as Motley & Green, and to act as ironfounders, etc.

WINTERINGHAM, LIMITED.—Capital £5,000 in £1 shares, to adopt an agreement with G. Winteringham, engineer, of Northampton, and to carry on the business of engineers, etc.

SANDERSON BROS., LIMITED.—Capital £3,000 in £1 shares, to adopt an agreement with R. Sanderson and J. Sanderson, and to carry on the business of engineers, etc. Registered office: 42, Railway Arches, Pilgrim Street, Newcastle-on-Tyne.

WARREN & BEALE, LIMITED.—Capital £2,000 in £1 shares, to acquire certain freehold land in Western Road, Leicester, with the foundry and other buildings thereon. Registered office: Highcross Iron Works, Causeway Lane, Leicester.

ERIC NICHOLSON & COMPANY, LIMITED.—Capital £10,000 in £1 shares. to carry on the business of manufacturers, hirers, and repairers of, and dealers in, oil, petrol, steam, and gas engines, etc. Registered office: Standard Works, Port Street, Annan.

A. S. WARD & COMPANY, LIMITED.—Capital £3,000 in £1 shares (1,500 pref.), to acquire the business carried on by A. S. Ward & Company at Broad Street. Sheffield, and to carry on the business of mechanical and electrical engineers, merchants, etc.

WALTER SCOTT & COMPANY (EDINBURGH), LIMITED.—Capital £500 in £1 shares, to acquire the business of electrical, mechanical, and general engineers, carried on at 148, Rose Street, Edinburgh, as Walter Scott & Company. Registered office: 148, Rose Street, Edinburgh.

H. V. SMITH & COMPANY, LIMITED.—Capital £10,000 in 9,575 "A" shares of £1 each, and 8,500 "B" shares of 1s. each, to adopt an agreement with H. V. Smith and H. B. Marten, and to carry on the business of ironfounders, engineers, etc. Registered office: 20, Victoria Street, S.W.

WORTLEY IRON COMPANY, LIMITED.—Capital £15,000 in £1 shares to take over the business of ironfounders carried on by J. Birdsell, G. Birdsell, C. Birdsell, and H. Birdsell, at Wortley, near Sheffield, as Wortley Iron Company. Registered office: Wortley Ironworks, Wortley, near Sheffield.

CHURCH IRON WORKS COMPANY, LIMITED.—Capital £15,000 in £1 shares, to acquire the business recently carried on by J. Wood at Ince, near Wigan, Lancs., as the Church Iron Works, and to carry on the business of ironmasters, ironfounders, etc. Registered offiec: 40, Brazennose Street, Manchester.

HERBERT & SONS, LIMITED.—Capital £3,000 in £1 shares (3,000 pref.), to adopt an agreement with G. Herbert for the acquisition of the business carried on by him at 6-7, West Smithfield, E.C., as Herbert & Sons, and to carry on the business of weighing-machine manufacturers, cutlers, machinists, etc.

SMITH GLASGOW CRUCIBLE COMPANY, LIMTED.—Capital £10,000 in £10 shares, to acquire the business of crucible and plumbago manufacturers carried on by Geo. Smith at Fauldhouse Street, Glasgow, and to carry on the business of makers of foundry requisites, etc. Registered office: 101, Fauldhouse Street, Glasgow.

WATTS & NEPHEW, LIMITED.—Capital £30,000 in £1 shares (20,000 pref.), to acquire the business carried on by Mildred Watts at Allcock Street, Birmingham, as Watts & Nephew, and to carry on the business of metal merchants, manufacturers of and dealers in copper, spelter, tin, etc. Registered office: Allcock Street, Birmingham.

HOUNSELL & WILLIAMS, LIMITED.—Capital £1,000 in £1 shares, to carry on the business of engineers, founders, machinists, etc., and to acquire the business of patentees, engineers, etc., carried on by W. G. Hounsell, Junr., at St. James's Works, 128, Hampton Street, Birmingham, and to adopt an agreement between W. G. Hounsell and S. Smith.

GAVEN INRIG, LIMITED.—Capital £2,000 in £20 shares, to acquire the business and assets of G. Inrig, Great Eastern House, 20, Bishopsgate Street Without, E.C., to develop and work the foreign patents granted to him for France, Belgium, Spain, Italy, Germany, Switzerland, Portugal, Canada, and U.S.A., and to carry on the business of electrical and general engineers.

Deaths.

MR. R. CHAMBERS, late ironmaster, of Bilston, died on the 17th ult., at Elmdale, South Yardley, in his 76th year.

MR. EDWARD WILSON, of the firm of Wilson Brothers, ironfounders, Dunfermline, died at his residence at Crossgates on the 14th ult.

THE death occurred at 9, Buccleuch Street, Glasgow, on the 23rd ult., of Mr. James M'Millan, of the Vulcan Iron Works, Glasgow, aged 71 years.

MR. T. N. ROBINSON, chairman and formerly managing director of Thomas Robinson & Son, Limited, Railway Works, Rochdale, died recently at his residence, Hillfoot, Pannal, Yorks., in his fifty-six year.

MR. S. W. W. PEECH, a director of the well-known firm of Steel, Peech & Tozer, Limited, steel manufacturers, Sheffield, died recently, at Fern Bank, Roehampton. He was 76 years of age.

Trades Boards Bill.

The above Bill, as amended in the Standing Committee, was considered in the House of Commons on July 16. SIR W. BULL moved to insert the following amendment:—"The Board of Trade may, by Provisional Order, declare that this Act shall cease to apply to any specified trade." SIR S. T. EVANS accepted the principle of the amendment, and at his suggestion it was withdrawn in favour of the following new subsection, which was agreed to:—"If at any time the Board of Trade considers the conditions of employment in any trade to which this Act applies have been so altered as to render the application of the new Act to this trade unnecessary, they may make a Provisional Order that this Act shall cease to apply to that trade." After other amendments had been defeated, MR. CHURCHILL moved the insertion of the new sub-section in the penalties clause, providing:—"That on conviction of an employer for failure to pay the minimum rate of wages, the court may order the offender to pay not merely a fine, but also such sum as might be deemed to be due to the workman on account of wages." The amendment was agreed to. SIR F. BANBURY moved the omission of Clause 7. MR. CHURCHILL said the Government proposed to accede to the pressure which had been brought to bear and the representations which had been made to them from many quarters not to verbally overweight the Bill. Therefore, he should not oppose the motion. At the same time, in justification of himself, he desired to say that he did not recede from the view he had previously expressed, that it would be an advantage to have the clause in the Bill. The motion to delete the clause was agreed to. The report stage was concluded, and MR. CHURCHILL moved formally that the Bill be read a third time. SIR F. BANBURY said if he could not get anyone to pair with him, he should divide the House against the Bill, which he regarded as a first step in the direction of the complete State regulation of wages. SIR H. CRAIK joined in the protest against the principles involved in the Bill. The opposition, however, was not pressed to a division, and the third reading was carried.

FOUNDRY LADLES.

28 LB.
—TO—
30 TON.

JAMES EVANS & CO., BRITANNIA WORKS, BLACKFRIARS, MANCHESTER.

TELEGRAMS—
"LADLES, MANCHESTER."
TELEPHONE—2297.

Personal.

Sir Andrew Noble has just been awarded the Albert medal by the Royal Society of Arts.

Mr. J. D. Ryan has been elected president of the Amalgamated Copper Company, in place of Mr. H. H. Rogers, deceased.

Mr. Henry Else has been elected a director of Wm. Cooke & Company, Limited, Tinsley Steel, Iron, and Wire Rope Works, Sheffield.

Sir Isambard Owen, principal of Armstrong College, Newcastle-on-Tyne, has been appointed vice-chancellor of the Bristol University in place of Professor Lloyd Morgan.

Mr. T. W. Jopling, of the firm of E. Jopling & Sons, Limited, Pallion Steel Works, has been the recipient of a presentation from the workmen and officials on the occasion of his marriage.

Mr. A. M. Mosscrop, who has just retired from the position of general manager of Dorman, Long & Company, Limited, has been the recipient of a presentation from the officials and men.

The late Mr. P. A. Berkley, of Parkside, Jesmond, Newcastle-upon-Tyne, for many years associated with the Palmer Shipbuilding and Iron Works, left estate of the gross value of £15,969.

Mr. Alexander Charles Boyd has resigned his position as a director of Bolckow, Vaughan & Company, Limited, owing to ill-health, and the directors have elected the Right Honourable James Parker Smith, P.C., to succeed him.

Mr. L. Thom, a director of Yates & Thom, Limited, Canal Foundry, Blackburn, was married recently, as also was Mr. R. W. Carr, principal partner of the firm of Messrs. Richard W. Carr & Company, Pluto Steel Works, Princess Street, Sheffield.

Major A. H. Hope, Secretary of the Iron Trades Employers' Insurance Association, Limited, having resigned his post on the ground of ill-health, Mr. S. W. Gladwell has been appointed to succeed him, and Mr. W. Ferns has been appointed assistant secretary.

Mr. A. C. Millar, foundry superintendent to John Lang & Sons, of Johnstone, has resigned that position to go to Belfast to become foundry superintendent with Davidson & Company, Limited, of that city. He has been the recipient of a presentation from the officials and men at Johnstone.

The late Major William Mackay Mackenzie, a director of Callender's Cable and Construction Company, Limited, of the London and Glasgow Engineering and Iron Shipbuilding Company, and of Milner's Safe Company, left estate of the gross value of £26,099, with net personalty £26,173.

Mr. L. W. Smith, A.M.I.C.E., has recently resigned the position of works director of Messrs. W. Sisson & Company, high speed engine manufacturers and marine engineers, Gloucester, and has been appointed managing director of Clarke's Crank & Forge Company, Limited, Engineers and Forgemasters, Lincoln.

Mr. A. B. Gowan, the new general manager of Palmers' Shipbuilding and Iron Company, Limited, Jarrow, has received from the foremen and officials of the London and Glasgow Engineering, Iron Shipbuilding Company, Limited, evidences of the respect and esteem in which they held him, in the shape of a handsome silver tray and a pair of silver salvers of beautiful design.

The Committee of the B. H. Thwaite fund has now received from Mr. Carnegie a cheque for his contribution of £500. The conditions which were attached to Mr. Carnegie's offer—namely, that a further £500 should be forthcoming from subscriptions from those who recognised the value of the service rendered to certain departments of science and industry by the late Mr. Thwaite—have not been complied with exactly, as the subscriptions did not reach a quite equal sum; but Mr. Carnegie has not allowed the actual cash shortage to stand in the way.

GANISTER, CUPOLA BLOCKS, FIRE BRICKS,
FIRE CLAY.
Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.
STEEL MOULDERS' COMPOSITION, SILICA CEMENT.
J. GRAYSON LOWOOD & Co., Ltd.,
DEEPCAR, nr. SHEFFIELD.
Telegrams: "LOWOOD, DEEPCAR."

The Old English Firm for Superior Quality and Cheapest
STRAW ROPES
IS PROCTOR BOWES & Co., Newcastle-upon-Tyne.
Write for Prices Immediately.
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BROKEN CASTINGS.

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ESTIMATES FOR WORK AND ILLUSTRATED PAMPHLET upon application to

THERMIT LIMITED,

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ELDERS FOUNDRY COKE

AS SUPPLIED TO THE BRITISH ADMIRALTY DOCKYARDS.

The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.
We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blowholes and other defects, than we formerly did.

From MOUNTFORD PHILLIPS & CO., Llantrissant.

Llantrissant, October 25th, 1904.

In reference to the Foundry Coke you have been supplying us with for the last six months, we have very great pleasure in letting you know that it has given every satisfaction, and that our Works Manager and Workmen give it the highest praise.

Elders Navigation Collieries, Ltd., Cardiff.

PRICES OF METALS.

The following table shows the approximate latest prices and position of stocks of metals during the past two years:—

METALS.	End July, 1909.	End July, 1908.
Iron—Scotch pig warrants ton	*54/4½	*55/6
—Middlesbro' warrants ... ton	48 9	50 1
—W.C. M/nos Bessemer ... ton	58 6	58 6
—Stock, Scotch ... ... tons	1,000	1,000
Copper—Chili bars, GMB ton	£59 0 0	£59 7/6
—Stock, Europe and afloat tons	†70,450	39 675
Tin—English ingots ... ton	£132 0 0	£127 15 0
—Straits ... ... ton	£132 15 0	£137 10/0
—Stock, London, Holland, U.S.A., and afloat ...tons	‡18,734	14,705
Lead—English pig ... ton	£13 0 0	£13 12 6
Spelter—Ord. Silesian ... ton	£22 0 0	£19 0 0
Quicksilver (75lb)... bottle	£8 5 0	£7 17/6—£8 0 0
Antimony—Regulus ... ton	£30 0 0-£31 0 0	£32 10/0

* Settlement price. † July 15th. ‡ June 30th.

CASTINGS.

In the Cleveland district the following are the nominal rates current for castings:—

	£ s. d.		£ s. d.
Columns (plain)	6 10 0	to	6 15 0
Pipes, 1½ to 2½ in.	4 17 6	to	5 2 6
,, 3 to 4 in.	4 10 0	to	5 0 0
,, 5 to 8 in.	4 7 6	to	4 10 0
,, 10 to 16 in.	4 7 6	to	4 10 0
,, 18 to 24 in.	4 7 6	to	4 10 0
Chairs	3 10 0	to	3 12 6
Floor plates (open sand)	2 17 6	to	3 0 0

SCRAP.

The quotations for scrap, subject to market fluctuations, are as follows:—Heavy wrought (mixed), £2 8s. 0d.; light wrought, £1 1s. 0d.; heavy cast, £2 7s. 0d.; all per ton f.o.b., London. Copper (clean), £54 0s. 0d.; brass (clean), £38 10s. 0d.; lead (usual draft), £12 0s. 0d.; tea lead, £10 10s. 0d.; zinc, £17 15s. 0d.; all per ton delivered merchant's yard.

Correspondence.

"K" Bars for Mechanical Testing.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—In your report in the July number of the FOUNDRY TRADE JOURNAL, on the paper I read recently before the Birmingham Branch of the British Foundrymen's Association, you state:—"Mr. Cook then explained *his* method of casting test bars in the form of the letter K." This would lead one to suppose that I claimed the origin of this test. As honour should be given to whom honour is due, and as this test originated with Mr. W. Vickers, with whom I am associated, I shall be glad if you will insert this in your next issue.

Yours, etc.,
F. J. COOK,
(President, British Foundrymen's Association.)

A SPECIAL meeting of the Pyle and Blaina Works Company, Limited, has been summoned to consider the appointment of a committee of shareholders to inquire into the position of the undertaking and the trading during the past two years.

SILICA FIRE BRICK Co.,
OUGHTIBRIDGE.

GROUND GANISTER,
WET OR DRY.

Silco Cupola Bricks, 90% Silica.
Better than Fire-clay Bricks for Cupolas.

Established 1863.

JAS. DURRANS & SONS,

PHŒNIX WORKS, PENISTONE, Near Sheffield.

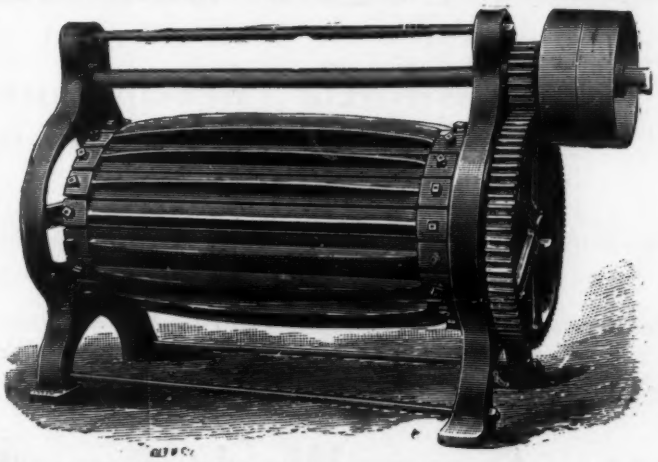
Manufacturers of all

FOUNDRY EQUIPMENTS,

COMPOSITION BLACK LEAD, PLUMBAGO, CORE GUM, WHITE DUST & COAL DUST.

Ladles, Cupolas, Fire Bricks, Gannister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, Etc.

IMPROVED FOUNDRY RATTLER or FETTLING DRUM.



These Machines are invaluable for a Foundry, doing a larger amount of work of a superior quality, in a much shorter time than can be done by hand, without skilled labour.

"Dear Sirs,—We have been using your best Blacking for a large number of years, and always use it on our large Ingot Moulds, which, as you know, we have made up to 85 tons in weight.

Yours faithfully, THE BRIGHTSIDE FOUNDRY & ENGINEERING CO., LD."

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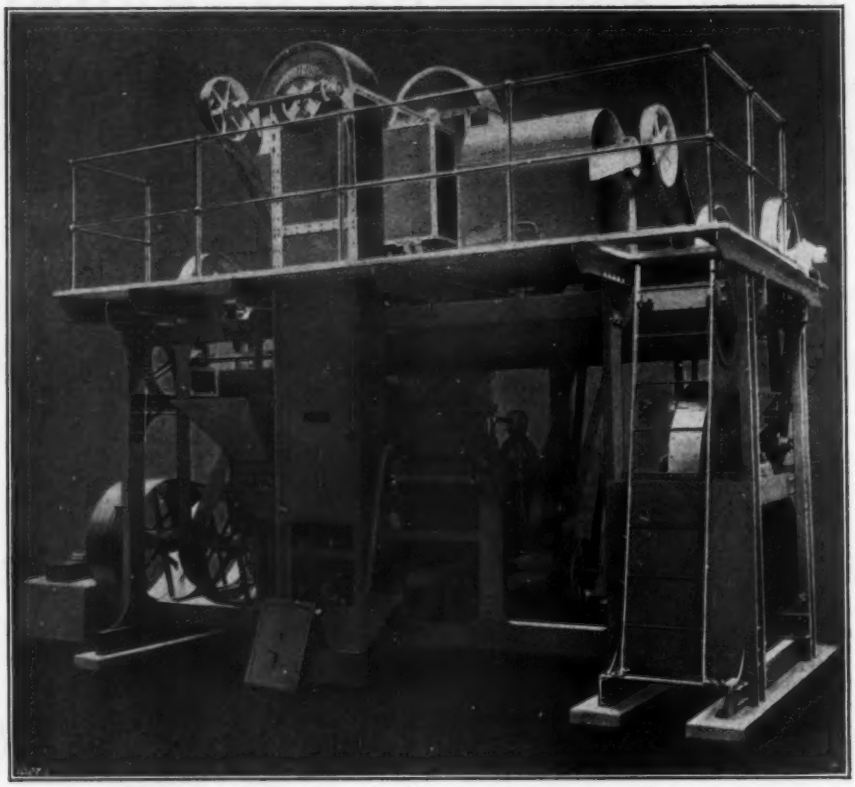

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Automatic Throughout.
Only One Operator Required.
Large Capacity.

Send for Pamphlet giving full particulars of this interesting Labour-Saving Apparatus.

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" B.—Grinding Machines, Emery and Corundum Wheels, etc.
" C.—Foundry Plant, and Blasts, etc.

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THE BUYER'S GUIDE

Addresses and further information will be found by reference to the Firm's Advertisement.

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Air Compressors.
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Phillips, J. W. & C. J.
Thwaites Bros., Ltd.
Tilghman's Patent Sand Blast Co., Ltd.

Air Compressors (Electrically Driven).
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Tilghman's Patent Sand Blast Co., Ltd.

Air Compressors (Steam).
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Tilghman's Patent Sand Blast Co., Ltd.

Air Compressors (Belt).
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Tilghman's Patent Sand Blast Co., Ltd.

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Jackman, J. W., & Co., Ltd.
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Phillips, J. W. & C. J.
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Olsen, Wm.

Blacklead.
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Evans, J., & Co.
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Olsen, Wm.
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Wilkinson & Co., Thos., Ltd.

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Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
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Marshall, H. P., & Co., Ltd.
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Samuelson & Co., Ltd.
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Ward, T. W., Ltd.

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Jackman, J. W., & Co., Ltd.
London Emery Works Co.
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Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
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Tilghman's Patent Sand Blast Co., Ltd.

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Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
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Marshall & Co., Horace P.
Olsen, Wm.
Plasti-Kion Co.
Silent Machine and Eng. Co.

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Durrans, J., & Sons.
Evans, J., & Co.
Hall, Charles, & Co.
Jackman, J. W., & Co., Ltd.
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Motherwell, Wm., & Co.
Olsen, Wm.
Wilkinson, T. & Co., Ltd.

Charcoal.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Walker, I. & I.

Charging Platforms.
Alldays & Onions Pneumatic Eng. Co., Ltd.
Davies, T., & Son.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Thwaites Bros., Ltd.

Coal Dust.
Cumming, Wm., & Co., Ltd.
Durrans, J., & Sons.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Olsen, Wm.
Walker, I. & I.
Wilkinson & Co., Thos., Ltd.

Coke (Foundry).
Elders Navigation Collieries.

Coke Breakers.
Evans, J., & Co.
Jackman, J. W. & Co., Ltd.
Marshall & Co., Horace P.
Phillips, J. W., & C. J.

Core Boxes.
Evans, J., & Co.
Jackman, J. W. & Co., Ltd.
Olsen, Wm.

Core Compounds.
Bush, H. C.
Cumming, Wm. & Co., Ltd.
Durrans, J. & Sons.
Evans, J., & Co.
Hall, Charles, & Co.
Jackman, J. W. & Co., Ltd.
Olsen, Wm.
Wilkinson, Thos. & Co.

Core Gums.
Durrans, J. & Sons.
Evans, J., & Co.
Hall, Charles, & Co.
Jackman, J. W., & Co., Ltd.
Olsen, Wm.
Walker, I. & I.
Wilkinson & Co., Thos., Ltd.

Core Making Machines.
Evans, J., & Co.
Jackman, J. W. & Co., Ltd.
Jones and Attwood.
London Emery Works Co
Marshall, H. P. & Co.
Phillips, J. W. & C. J.

Core Ovens.
Alldays & Onions Pneumatic Eng. Co., Ltd.
Evans, J. & Co.
Jackman, J. W. & Co., Ltd.
London Emery Works Co.
Phillips, C. D.
Phillips, J. W. & C. J.

Core Ropes.
Bush, Henry C.
City of London Wood Wool Co.
Durrans, J. & Sons.
Evans, J., & Co.
Hall, Charles, & Co.
Jackman, J. W., & Co., Ltd.
Olsen, Wm.
Wilkinson, T. & Co.

Core Vents.
Bush, Henry C.
Evans, J., & Co.
Jackman, J W., & Co., Ltd.
Olsen, Wm.

Cranes.
Alldays & Onions Pneumatic Eng. Co., Ltd.
Jackman, J. W., & Co., Ltd.
Ward, T. W., Ltd.

Crucibles.
Hall, Charles, & Co.
Olsen, Wm.

Crucible Furnaces.
Alldays & Onions Pneumatic Eng. Co., Ltd.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Simplex Coke Oven and Engineering Co., Ltd.

Crucible Furnaces (Lift-out)
Alldays & Onions Pneumatic Eng. Co., Ltd.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Phillips, J. W. & C. J.

Crucible Furnaces (Tilting)
Alldays & Onions Pneumatic Eng. Co., Ltd.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Phillips, J. W. & C. J.

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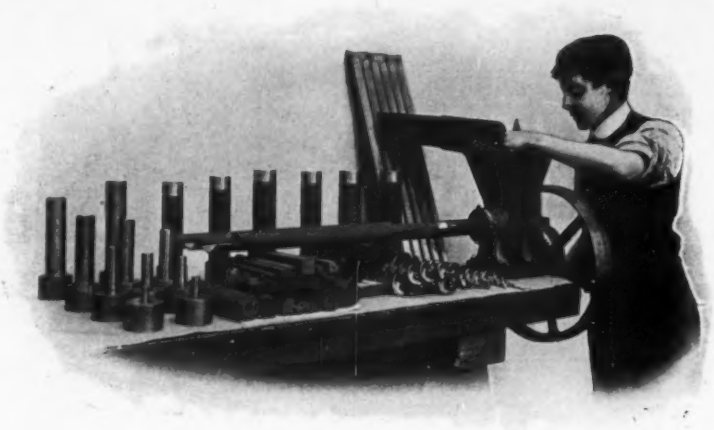

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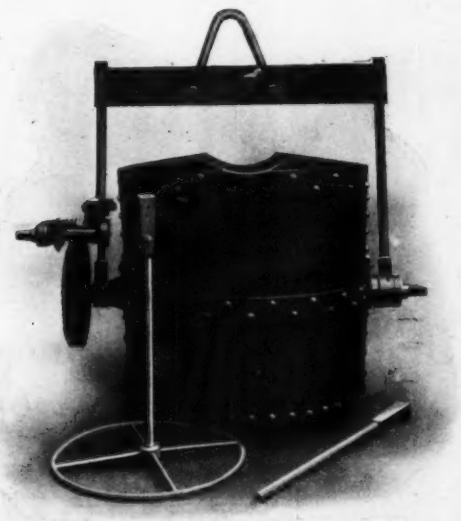

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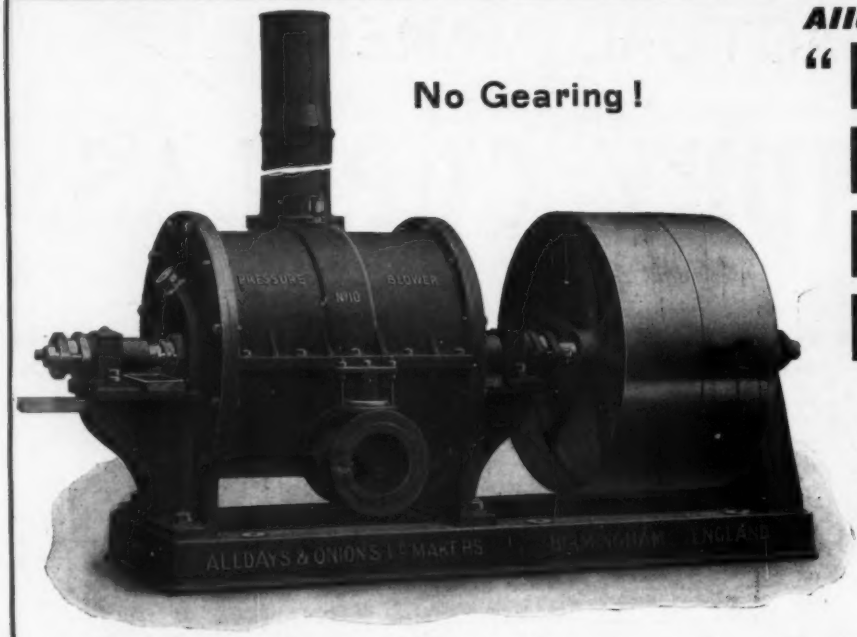

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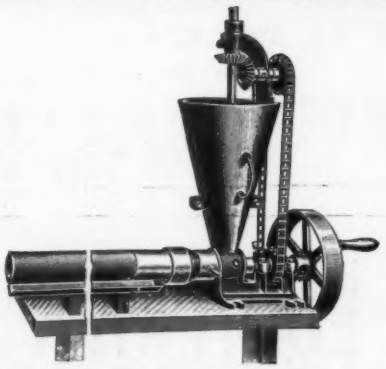

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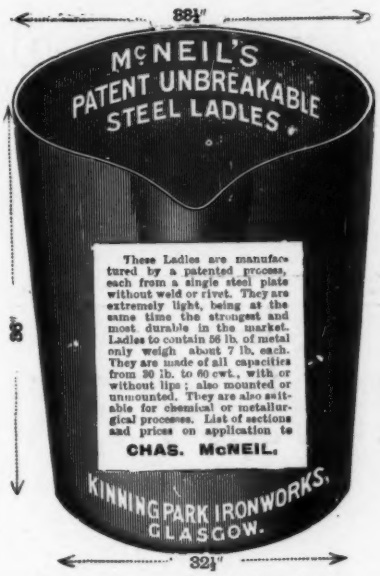
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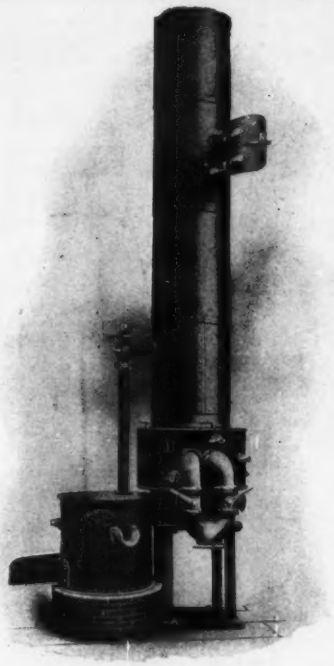

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